Health Risks - Cancer

As long ago as 1948, the US reported a possible link between microwaves and testicular degeneration in dogs. In 1953 a study of workers at Hughes Aircraft Corporation found excessive amounts of internal bleeding, leukaemia, cataracts, headaches, brain tumours, heart conditions, etc. in those employees working with radar. In 1976, Soviet military research into microwave radiation at modern mobile phone frequencies, found brain damage in rats subjected to less than 1 / 100th of the radiation emitted by mobile phones; higher risk of heart disease in men exposed to microwave radiation; pre-cancerous cells linked with leukaemia and Hodgkin's disease in exposed workers; memory loss and headaches identical to those reported by mobile phone users; and damage to the immune system. In 2005 it was admitted that a new British army radio produced levels of radiation higher than those allowed by the HPA-RPD. Soldiers are being issued with health guidelines warning them not to stand nearby when the radio is in use for fear of cancer. Mobile phone users expose their brains to higher mean intensities than military personnel are allowed to be exposed to when repairing radar (Cherry 2001).

In the 1990s, according to the Cancer Atlas of the United Kingdom and Ireland 1991-2000, brain cancer and lymphomas increased all across the UK, and leukaemia, testicular, laryngeal, prostate and uterine cancer rates have gone up nearly exponentially. The tissue in the larynx is particularly sensitive to microwave radiation (Goldberg 2006), as are the testicles. Goldberg says "*Regardless of the type of exposure, the effects of the radiation are cumulative. That is if you received a large exposure over a short period of time, or if you received a low dose exposure over a longer period of time, the results are the same. The total exposure is cumulative; in essence there is no safe dose.*" Certainly some of the phone use reported by Hardell (below) as resulting in an increased risk of brain tumour, consists of very small numbers of hours indeed over a long period of time. Interestingly, there seems to be less evidence of problems, with a short, high, exposure. We have wondered if perhaps the body's own defence mechanisms kick in if high levels are detected, whereas this mechanism is not triggered by low levels which 'get under' the body's natural defences.

Dr John Holt, an oncologist, (1996) in Australia has shown repeatedly that a few minutes exposure to cell phone type radiation can transform a 5% active cancer into a 95% active cancer for the duration of the exposure and for a short time afterwards. Dr Ross Adey (1999) exposed pregnant rats and their offspring to a modulated RF signal such as would be emitted from a mobile phone. He found an increased incidence of tumours of the central nervous system among rats which had been given a carcinogen, suggesting that the RF exposure triggered the carcinogen to become an active cancer.

Some users can develop quite serious health consequences immediately after a call, which can persist for up to an hour or so after they stop using the phone. Other people experience similar symptoms but it takes longer for them to appear. Thomas (2008) measured mobile phone use in a randomly selected group and found no association between exposure and acute or chronic symptoms. The measurements for the acute symptom group were only over 24 hours, so it may be that the people did not react immediately.

An analysis of published scientific studies of mobile phone use and brain tumour incidence by Lloyd Morgan, Director of a USA Cancer Registry, shows very concerning results and a definite association with mobile or cordless phone use and some sorts of brain cancer. A study by Redmayne (2010) found a high correlation between mobile phone and cordless phones among Australian young people, with cordless phone use being higher, which may affect the results of some studies into mobile phone use, underestimating both cases' and controls' exposure to RF

radiation. Most worryingly is the fact that brain tumours are usually only diagnosed 10 to 25 years after they were initiated. We are only just reaching the period when many people have been using their mobile phone for ten years, and to already see a significant trend is concerning.

As early as 1995, the late Dr Ross Adey, one of the world's most respected and senior research scientists stated "*The laboratory evidence for non-thermal effects of both ELF (power-frequency) and RF/ microwave fields now constitutes a major body of scientific literature in peer-reviewed journals. It is my personal view that to continue to ignore this work in the course of standard setting is irresponsible to the point of being a public scandal.*"

The Royal Society of Canada's report in 1999 said, "there are documented biological effects of RF even at low, non-thermal exposure levels including a) blood-brain barrier permeability changes, b) DNA damage, and c) increased cancer in rats".

In March 2001, the Chairman of the Independent Expert Group on Mobile Phones (IEGMP), Sir William Stewart, gave oral evidence to a Trade and Industry Select Committee Inquiry [Trade & Industry 2001, HC330], that included: "*Overall the balance of evidence to date - this is a carefully constructed phrase - suggests that exposure to RF emissions below the national guidelines do not cause adverse health effects to the general population. However, we went on to say that there was now scientific evidence that there may be biological effects occurring at exposures below those guidelines. Biological effects do not necessarily translate into health effects, but neither do they necessarily* **not** *translate.*"

In August 2002, Professor Michael Kundi and colleagues at the University of Vienna collaborated on producing an information booklet on Mobile Phones and Children, discouraging their use. He emphasised an aspect of cellular biology that he believes has been omitted in discussions of RF radiation and its effect on developing brains "*A child's skull is not only thinner and surely has different dielectric properties because it has more blood vessels - it also contains many more stem cells which can form blood cells. Hence, if RF-MW radiation has an influence on the development of cancer, its effects will be greater for two reasons. First the most vulnerable cells are only millimetres from the antenna. (To my knowledge, nobody has calculated the SAR within the bone marrow of the skull.) And second, the earlier in life a malign transformation occurs, the more likely it will result in a clinical malignancy*".

In May 2010, the US President's cancer Panel reported that "the true burden of environmentally induced cancers has been grossly underestimated" and named cell phones and other wireless technologies as potential causes of cancer that demand further research and precaution. In May 2011, after reviewing 21 scientific studies from 14 countries, the World Health organisation (WHO) warned for the first time that mobile phones may cause cancer (Baan 2011).

Even the evidence we now have can only tell us about the damage that is being done today. For more slowly developing illnesses such as leukaemia, other cancers, Alzheimer's and other dementias we will have to look for the results in 5, 10, or even 30 years hence, as is the case with asbestos exposure and cancer diagnosis. UK deaths from mesothelioma (an asbestos-induced cancer) are due to peak between 2020 and 2030 despite the use of asbestos having been banned in the UK for many years.

Roger Coghill, an independent UK scientist, has shown that at field strengths commonly found near mobile phones, and in fact, near other appliances, at any frequencies, "*cause nitrites to form in virtually any aerated aqueous solution, and with chronic exposure (say 48 hours) achieve concentrations shown by a number of competent studies to de-aminate DNA and impair oxidative phosphorylation.*" He says "*this demonstrates how tumours might derive from such non thermal exposures.*" Donnellan (1997) found the rate of DNA synthesis and cell replication increased after exposure to 835 MHz radiation.

Not all studies find effects; Prisco (2008) found no effect of RF on bone marrow precursor cells which would have an impact on carcinogenesis, neither did Smith (2007) find increased incidence of cancers in rats exposed to GSM and DCS wireless signals.

In 2002, the German Interdisciplinary Association for Environmental Medicine (IGUMED), said that some of the medical conditions they saw as a consequence of the technology were: learning, concentration and Attention Deficit Disorder; extreme fluctuations in blood pressure, which are harder to influence with medications; heart rhythm disorders; heart attacks and strokes among an increasingly younger population; brain-degenerative diseases (such as Alzheimer's); epilepsy, leukaemia and brain tumours. Some of these are covered in Sections 3, 4 & 5 of this article.

Dr Michael Repacholi, who used to be Head of the WHO EMF Project said "*Mobile phones have only been around for less than 10 years now and the incubation period for cancer is at least 10, maybe 15 years. So we need to set up the studies so that if there is an impact, it can be found in a reasonable time. With a large study looking at mobile phone users we would see if there is anything we do not yet know about their impact on health.*" In view of what Dr Repacholi said about the time scale for cancer development we wonder whether a few years (the time scale of most longitudinal studies) is long enough to make the 'definitive statement' that WHO believes is possible.

Carl Blackman, past president of the Bioelectromagnetics Society, concluded in a paper published in March 2009, *"the international reviews of the research area since the 1986 report* [National Council for Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, National Council for Radiation protection and Measurements 1986, 400 pages], *have not included scientists with expertise in non-thermal effects (NTE), or given appropriate attention to their requests to include NTE in the establishment of public-health-based radiation exposure standards. Thus, those standards are limited because they are not comprehensive."*

In October 2007, it was reported that Lloyd's of London was preparing for the next big liability action – for personal injury damages based on the use of cell phone technology. The questions exercising their corporate minds are *"What would happen if, say in 20 years time, the link between the electromagnetic fields (EMF) generated by mobiles is proven to be linked with a high susceptibility to illness? How are London's underwriters protecting themselves from opening the floodgates to future claims without prejudicing policyholders?"*

A team of Australian scientists investigating possible links between cellular phones and cancer has turned up a most significant finding of adverse health effects. The study looked at 200 mice, half exposed and half not, to pulsed digital phone radiation similar to a mobile phone transmitting for two thirty-minute periods each day. The work, conducted at the Royal Adelaide Hospital, led by Dr Michael Repacholi, Director of the World Health Organisation EMF Project revealed a **highly-significant doubling of cancer rates** in the exposed group (1997). Using HPA figures, most GSM digital cell-phones will be putting between 10 and 30 times more radiation into the user's head than the mice were subject to.

Norman Sandler, a spokesman for Motorola disputed this finding after a report published in August 2002 in the International Journal of Radiation Research, by an Australian team did not find this effect. This is hardly surprising as buried deep within the paper we find that 75% of the ***control*** mice developed cancer; so it is very unlikely that they would get a statistically significant result from such an odd experimental group of mice. We wonder whether they did set out to find the truth, or whether they had other motives?

The Australian Sydney Morning Herald (January 2002), reported the latest research at St Vincent's Hospital on live human brain cells that are being used to test the long-term effects of mobile phone radiation. The team, led by Dr Peter French is testing the centre's hypothesis that

mobile phone radiation could cause cancer in habitual, long-term users. The cells are exposed to four daily one-hour time slots of radiation. As the tests were for three to six months, is this really a long-term effect?

It is accepted that short term exposure of mice, or isolated cells, is not conclusive in determining potential risk factors in human cancer development. Cancer is being increasingly recognised as an 'organisational systems' problem, ***and no short term speeded up animal experiments are likely to give the same results as extended chronic exposure to humans***. Neither are the number of studies that are investigating static fields.

In a review of studies of the risks of carcinogenesis from mobile phones and their infrastructure, Yakymenko (2010) concluded *"The lack of generally accepted mechanism of biological effects of low-intensive non-ionizing radiation doesn't permit to disregard the obvious epidemiological and experimental data of its biological activity. Practical steps must be done for reasonable limitation of excessive EMR exposure, along with the implementation of new safety limits of mobile telephony devices radiation, and new technological decisions, which would take out the source of radiation from human brain."*

The 13-nation Interphone study findings, and others.

The Interphone studies have been highly criticised for inconsistency. A paper by Lloyd Morgan (2009) states *"The Interphone studies have 11 flaws, and the Swedish studies have 3 flaws"*. The 11 flaws are: selection bias; insufficient latency time; definition of 'regular' phone use; exclusion of young children and adults; no investigation of brain tumour risk from cell phones radiating higher power levels in rural areas; exclusion of exposure to other transmitting sources; exclusion of some brain tumour types; exclusion of tumours outside the cell phone radiation plume; exclusion of brain tumour cases because of death or illness; recall of accuracy of cell phone use; and funding bias. Although the Interphone studies are being held up by industry and governments as the ultimate word on the health effects of mobile phones, it is difficult to see how this position can be maintained in view of the flaws they clearly possess. However, many of them show increased risk of different types of brain tumours that are concerning, especially if the risk is underestimated.

Here are some of the findings:

- In 2005, Schoemaker's study including 5 countries, found almost a doubling in risk of developing acoustic neuromas after 10 years of mobile phone use. Schüz did not find this effect (2011), in fact, he found that using a mobile phone had a slightly protective effect. We have come to expect that Schüz often finds no effect when compared with other researchers' results, however, he did conclude that because of the usually slow growth of acoustic neuromas and possible diagnostic delay, the situation needs to be monitored carefully.

- In 2006, in a UK study by Hepworth, a significant increase in the risk of developing gliomas on the same side of the head as the patient said they most often held the phone was found. This finding, was despite the fact that the researchers excluded half the people who developed gliomas because they died before they could be interviewed. In 2009, Hartikka found a doubling in incidence of gliomas in phone users.

- Schüz, who led the German team (2006), found a doubling in risk for gliomas after 10 years mobile phone use. A further German study was published in the BMJ in June 2008, stating that *"mobile phones, cordless phones, and cordless base stations next to beds are safe, pose no risk of cancer to adult users and do not cause headaches or sleeping problems."* This turned out to be a grossly misleading summary of the study which ***actually*** concluded *"High frequency electromagnetic fields such as those found, for example, near transmitters (e.g. radio*

frequency towers and mobile telephone base stations) or when using mobile end devices (cell phones) are suspected of having adverse health effects on man." The misleading BMJ summary ***did*** mention that genetic activity changed after irradiation, and that the study authors could not say whether exposure for more than 10 years posed any risks to health.

- In 2007, a group led by Lahkola studying cases of glioma from 5 North European countries, found that regular mobile phone use for 10 years or more was associated with an increased risk of developing this type of brain tumour. The increased risk was found despite the fact that 'regular' was defined as 'on average once a week during at least 6 months.' This definition is likely to dilute the findings, including, as it will, people who hardly ever use their phones. Therefore the actual increased risk may well be higher. They found a significantly increased risk of developing a tumour on the side of the head that the phone is used.

- The Israeli study (Sadetzki 2008) found a 50% increased risk of developing salivary gland tumours (PGTs), both benign and malignant. The risk was higher the more the phone was used. They concluded *"Based on the largest number of benign PGT patients reported to date, our results suggest an association between cellular phone use and PGTs."* Cigarette smoking was significantly more common among the cases and may indicate a synergistic effect. A greater number of regular mobile phone users had tumours on the same side of the head they held the phone to. The authors recommended a precautionary approach to mobile phone use, as their results suggested a relationship between long-term and heavy cellular phone use and parotid gland tumours.

- The study by Deltour (2009) looking at the incidence of glioma and meningioma between 1974 and 2003 reported no significant increase. This is not really surprising as the time scale is too short to identify an increased risk for mobile phone use as they have not been in widespread use for long enough even at the latter end of the research data. Dr Alison Ross, Cancer Research UK's senior science information officer said *"Overall, the scientific evidence tells us that using mobile phones for less than 10 years does not increase the risk of cancer. However, brain tumours often take a very long time to develop so we will need to look for any future changes in incidence rates to see if mobile phones could pose any longer-term risks."*

- Cardis (2010) reported a greater incidence of brain tumours on the same side of the head as the side they habitually used to make phone calls. This was reported after relatively short-term use compared with brain tumour latency periods, and the authors concluded that "*The possible effects of long-term heavy use* [about 3 hours a week] *of mobile phones require further investigation."* This suggestion was supported by Saracci & Samet (2010).

In 2010, The Interphone Study group finally reported an increased risk of glioma and, to a certain extent, meningioma at the highest exposure levels, for ipsilateral exposures, and for glioma, for tumours in the temporal lobe. They did not separate out users aged 20-29, the age group that Hardell has found particularly susceptible to developing brain tumours.

Brain tumours

Whether mobile phone use causes brain tumours or not is difficult to establish for certain. This is possibly because:

a) it can take 5 -15 years from initiation to the clinical diagnosis of a brain tumour (though some researchers (Abdus-salam 2008) have suggested we need to allow up to 40 years when analysing brain tumour risk), or

b) people may not be equally susceptible to RF-induced brain cancer, possibly in absolute numbers or in the way it develops. It may be that brain cancers occur not directly as a result of RF exposure, but via an intermediary condition such as a reduction in the immune response, or multi-causal factors (genetic predisposition, chemical DNA damage, virus infections, occupational exposure, lifestyle, etc) or off-setting factors.

An example of an off-setting factor could be that brain cancer rates might be much higher in those people who have easy RF breaches of the blood-brain barrier. These susceptible people may experience symptoms from mobile phone use that result in their significantly reducing their usage times.

Lloyd Morgan, Director of the Central Brain Tumour Registry of the United States, said that based on a 30 year latency time for brain tumours, he projects that there could be up to 1.6 million mobile phone brain tumours in the USA by 2019. At a treatment cost of $250, 000 per patient, this would cost $400 billion. It would also require Significantly more neurosurgeons by then.

New Zealand's Dr Neil Cherry found 66 epidemiological studies showing that electromagnetic radiation (EMR) across the spectrum increases brain tumours in human populations. "*I am expecting, because these cell phone exposures of the head are far higher than even the highest military exposures for which we find very large increases in cancer, that cell phone users will be showing these symptoms. But the latency of cancer is decades. And so we need to study a large population for about two to three decades using these cell phones for a large increase in brain tumours to be observed*".

In 2004 a review of cell phone research by Michael Kundi and colleagues in Vienna revealed that nine published studies showed an enhanced cancer risk from cell phones with increasing risk for longer duration of phone use. In a later paper Kundi looked at 33 epidemiologic studies in the peer-reviewed literature about mobile phone use and cancer, 25 of which were about brain tumours (2009). He concluded there was an increased risk, but it was difficult to quantify because of insufficient information on long-term use. Repacholi (2011) was also cautious about making statements about the risk of long-term risks of brain or other head tumours at this time, after a review of papers available.

Khurana (2009) also reviewed 11 papers and concluded that "*there is adequate epidemiologic evidence to suggest a link between prolonged cell phone usage and the development of an ipsilateral brain tumor*". Larjavaara (2011) found that gliomas were located in the part of the brain closest to the source of RF exposure from a mobile phone. Ali Kahn (2003) found right sided gliomas in right handed people, but not statistically significant. The study was quite early to detect cancer incidence.

Takebeyashi (2006) found only a very slight increase in the risk of acoustic neuroma 5 years after mobile phone use started. They only recruited people between 2000 and 2004, so maybe we wait and see, until the data is more up to date with respect to current phone use.

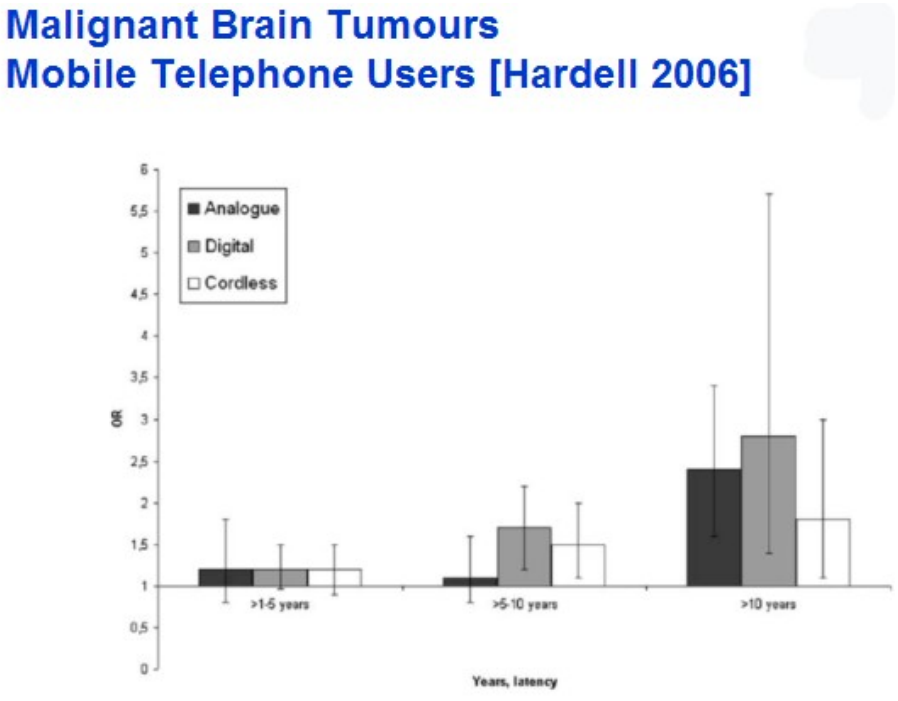
Mobile phone use may not cause brain tumours but may influence the speed of development of the tumour. There has been an unexplained 40% increase in brain tumours in Australia in the last 20 years.

- A team at the Duke Comprehensive Cancer Center in North Carolina is heating up tumours with microwaves. This opens up the pores in blood vessels, and allows the liposomes used in chemotherapy to enter the tumours. It is uncertain what may be allowed into the brains of healthy people when exposed to microwaves.

- Professor Henry Lai (1992, 1994) of the University of Washington, Seattle, has spent many years researching the biological effects of microwaves. In 1995 & 1996, papers by him and

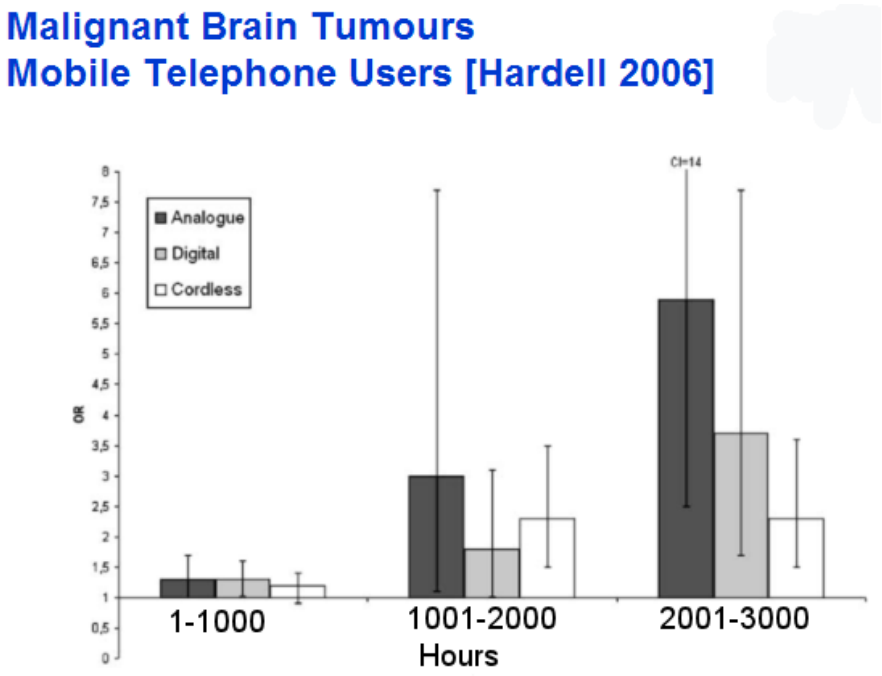
his colleague Dr Narendra Singh demonstrated that damage occurred to DNA strands in the brain cells of rats when exposed to radiation similar to that emitted by a mobile phone. This meant the cells were either dying or going cancerous.

- Dr George Carlo found that the rate of death from brain cancer is higher among mobile phone users, and the risk of their contracting a rare brain tumour is more than double. There was a correlation between brain tumours on the right side of the head and use of the phone on the right side of the head (2001). His laboratory studies found that radiation caused genetic damage, duplicating Professor Lai's studies.
- A study by Cardis (2008) examined the distribution of energy within the brain as a result of mobile phone use. She found that over 97% of the radiation was absorbed in the brain hemisphere where the phone is used, more than 50% in the temporal lobe. She concluded *"Analyses of risk by location of tumour are therefore important for the interpretation of results of studies of brain tumours in relation to mobile phone use."* What cannot always be determined is the percentage of time spent holding the phone to the other side of the head as symptoms attributable to tumour growth (before diagnosis) make holding the phone on the original side uncomfortable.
- In Sweden, Lennart Hardell, a cancer specialist, and colleagues (2000, 2001, 2002, 2002, 2003, 2009) found the risk of getting brain cancer was at least 2.5 times higher for people who used mobile phones and DECT cordless phones frequently for more than 5 years, or 3.4 times higher after having used a phone for 2,000 hours or more (Hardell 2010). In 2002, from what is claimed to be the largest case-control epidemiology study in the world (1,617 cases and a similar number of controls), he published 3 papers reporting significant increases in risk of benign brain tumours, malignant astrocytomas, and acoustic neuromas amongst mobile phone users.



In 2006, Hardell and colleagues found that the risk of developing malignant brain tumours and acoustic neuromas increased with time, and the cumulative number of hours the phone was used. This was true of analogue and digital mobile phones. Using a cordless telephone for 98 hours in 5 years (e.g. 98 minutes a month or 3 minutes a day) increased the risk by a half. Using it for 5 more years doubled the risk, and more than 10 years nearly tripled the risk (Hardell 2006). Professor Hardell commented *"The health risks from a DECT phone are the same as for a regularly used mobile.*

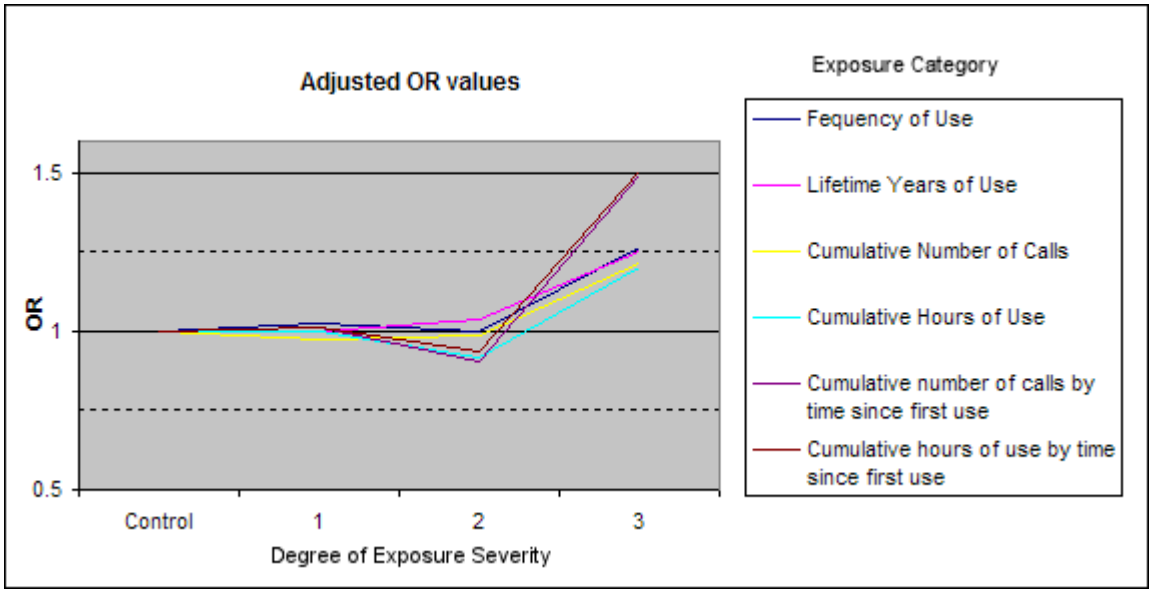
They are usually in rooms where people spend a lot of time and people tend to spend longer on them than they do on a mobile."



Hardell found that people under the age of 20 years were almost 4 times more likely to develop a malignant brain tumour if they used a digital mobile phone (Hardell 2006b). They were twice as likely to do so if they used a digital cordless phone.

- Lönn from the Karolinska Institute in Sweden (2004) found a doubling of risk for acoustic neuroma after 10 years and a quadrupling of risk for a tumour on the same side of the head as a phone was used. They found no increased risk for parotid gland tumours (2006).

Of the most severe points on the graph below, two are now fully statistically significant and three are marginally statistically significant, all for increased brain tumour risk.



For further commentary on these findings see:

http://www.powerwatch.org.uk/news/20070124_mobile_phone_glioma.asp

- In April 2002, Dr Joshua Muscat (New York University), published a study in the journal Neurology, in which they "*found no link between mobile phone use and acoustic neuromas*". There was a time-scale problem with this study in that Dr Muscat said that their study focused on short-term mobile phone use and recommended more studies on longer-term use. He did, in fact, find a slightly elevated risk for subjects with three or more years of phone use. This seems to support Hardell's findings. In 2011, Sato found a tripling in risk of acoustic neuroma with the use of a mobile phone for more than 20 minutes per day on average.

Earlier (2000), Dr Muscat had reported a doubling in risk of neuroepithelial tumours, a rare form of soft brain-tissue cancer, and in 2006, he reported that mobile phone use is unrelated to the risk of neuronal cancers. There is quite a discussion about Muscat's results and spin - see: http://www.powerwatch.org.uk/news/20000602_vodafone.asp

- Salahaldin & Bener (2006) found that the newly developed country, Qatar, had a higher incidence of acoustic neuroma than in other countries. Mobile phone use in tumour patients averaged at 14 times per day (8-20 range) for more than 5 years.

In September 2007, Lawrie Challis, (chair of the Mobile Telephony Health Research) group said there was a "*slight hint*" of increased risk of brain tumours among long-term mobile phone users. Because children have been shown to react differently to environmental stimuli, he felt it "*possible that they were at greater risk*".

In 2008, Hardell evaluated 10 studies on gliomas, 9 studies on acoustic neuromas, and 7 studies reporting on meningiomas. He concluded that the meta-analysis gave a consistent pattern of an association between mobile phone use and ipsilateral (same side of the head that the phone is used) glioma and acoustic neuroma when the phones had been used for 10 years or more. Another meta-analysis by Levis (2011) found almost a doubling of the risk of head tumours induced by long-term mobile phone use.

A study from Denmark by Schüz (2006) found no evidence of increased risk of developing a tumour with short or long-term use of a mobile phone. This was hardly surprising, as, amongst other shortcomings, the study ignored all mobile phone users that started their contracts after 1995 (most mobile phone users in the country now fit into this category) and ignored all non-contract usage (pay as you go). As a result, the control group will include at least as many mobile phone users as the supposedly exposed group, and probably considerably more unless it is really true that less than 16% of the Danish population use a mobile phone. Another study by Schüz et al found no effect (Christensen 2005). A study by Lehrer (2010) found a significant correlation between the number of mobile phone subscriptions and brain tumours in nineteen US states.

Stang (2001) found a 4-fold increase in risk of developing uveal melanoma, a cancer of the eye, as a result of exposure to mobile phones, though a subsequent study (2009) found no such association. Johansen (2002) found no increase in the incidence of malignant melanomas with the growth of mobile phone use in Denmark, neither did Frei find an increase in CNS tumours (2011), though the study is seriously flawed.

AH, aged 43 (reported in the Mirror November 2009), is convinced the rare ameloblastoma tumour in his jaw was caused by his heavy phone use – 6 hours a day, and then he slept with it next to him. NW, aged 52, developed a near-fatal acoustic neuroma in 2001 and believes (as does his consultant) that it was a direct consequence of years of heavy mobile phone use (Wigan Evening Post, November 2009).

There have been large increases in thyroid cancer in the USA since the 1980s (Chen 2009). Thyroid cancer is known to be caused by exposure to ionising radiation, but there has been no

evidence of an increase in exposure to such radiation among Americans. Another cause is felt to be responsible. Primary tumours under 1 centimetre have increased almost 10 % per year in men and 8.6% per year in women. Larger ones exceeding 4 centimetres increased 3.7% per year in men and 5.7% per year for women. Cancers that had spread are also increasing at a similar rate.

Of course, the thyroid gland is in the neck, close to where a mobile phone is held. DNA damage here could cause thyroid cancer, and it could also result in a partial loss of thyroid activity in some people, causing hypothyroidism, one symptom of which is obesity. People have wondered whether this might add to the possible causes of the obesity problems faced by society.

Milham (2008) found a 13 times higher risk of thyroid cancer among teachers exposed to dirty electricity in the schools where they worked, with a much shorter latency time (3 years) compared with other cancers (10 years). One of the authors (Lloyd Morgan) suggests that thyroid tissue may therefore be particularly vulnerable to non-ionising as well as ionising radiation.

In a discussion paper by Belyaev & Grigoriev (2007), they concluded that "*It has been shown that non-thermal microwaves affect cells of various types including stem cells and reproductive organs. Stem cells represent especially important cellular model because recent data suggest that different cancer types, including leukemia, have a fundamentally common basis that is grounded on epigenetic changes in stem cells.*"

Şimşek (2003) found that mobile phone use did not significantly affect prostate-specific antigens (PSA) values (high levels indicate a greater likelihood of the presence of cancer), at least in the short-term.