Mobile Phones

The Mobile Phones set of articles is separated into 9 sections, each of which can be individually downloaded. It is a 'work in progress' incorporating new information whenever time permits.

Section 8
Things you can do to reduce your RF exposure

1. Introduction; children and safety; mobile phone addiction; tracking and tapping phones; the impact of adverse weather patterns on phone calls; the environmental impact of the technology
2. Are mobile phones a health problem? Is the data trustworthy?
3. Brain tumours and other cancers; 13-nation Interphone study findings, and others; brain tumours; eye cancer; leukaemia; melanoma; personal experiences; prostate; skin tumours; stem cells; thyroid cancer; implications; Legal viewpoints
4. Dementia; reproductive effects; neurological effects; cognitive effects; brain activity, children
5. Biological control systems; heat shock protein; DNA; interaction with other environmental exposures and indirect affects; cellular mechanisms; blood changes
6. Other health effects; general; allergies; babies; bacteria; bladder; bone growth; bone healing; brain changes; cardiovascular changes; chronic fatigue syndrome (CFS); CNS effects; depression; diabetes; ear effects and hearing; emotionality; epilepsy; eye effects; gastric effects; growth; hand and arm effects; headaches; heart; kidney damage; life span; liver; migraines; mouth; multiple sclerosis; neuropathic pain; pain perception; personality changes; salivary gland effects; skin; sleep; stress; tinnitus; other effects; drug and other interactions; complexities of study design that may result in finding 'no effects'; animal, insect and plant experiments and effects; indirect effects; protective effects
7. UK and international regulations and guidelines; exposure places and bans, hospitals, physical therapies, prisons, railways, rural areas; Austria; Belgium; EU; France; Germany; India; Israel; Italy; Japan; Poland; Russia; Taiwan; USA
8. Things you can do to reduce your RF exposure. Phone, time, signal strength, switching off Blackberrys; vulnerable areas; texting; standby; other people; when travelling; headsets; SARs; antennas; electromagnetic noise; protective gizmos; supplements
9. References – 609 references

Things you can do to reduce your RF exposure

Phone

- **Use corded telephones for regular calls, longer calls, as your "first phone"**.

However, if you need to use a mobile, in order to avoid having to think of all the different aspects of safe use detailed below, you might want to buy a Phone Pouch from EMFields

- There is a range of covers and sizes that have been scientifically tested to reduce your exposure to radiofrequency radiation (RF) when you use your phone or you simply carry it around on standby.

or use a headset – see below.

Time

Two of the main recommendations (also recommended by the Departments of Health and Education) are:-

- **Use your mobile phone only when necessary**
- **Keep the call short**

Beware operators advertising "unlimited weekend minutes; talk time of up to 200 minutes and standby up to 180 hours." The temptation to 'get your money's worth' can prove irresistible, yet potentially very damaging.

Signal strength

On each mobile phone there is an indication of the signal strength in the area. This is usually shown with a series of bars. The more bars, the stronger the signal. When a phone is used in a strong signal area it can **use** a lot ***less*** transmit power and so will give off fewer emissions. When you use your phone, make sure that the antenna is as far as possible from your head and hand. Even half an inch makes a huge difference in the strength of the electromagnetic field entering your body. NEVER place any fingers up behind the earpiece to press it to your ear as more of the radiation is channelled into your head and arm and the handset is forced to operate at a much higher transmitter power.

When indoors, always use the phone near a window, where the signal strength can be up to ten times greater than in the centre of the room (meaning that the handset powers up less to establish

contact with the mast) and always hold the handset on the window side of your head (so that less of the signal passes through your head to and from the phone mast).

- **Make sure there are a lot of bars showing and the antenna is as far from your head and hand as possible**
- **Never place your fingers up behind the earpiece to force the phone closer to your ear. Turn up the volume if necessary.**
- **Indoors, use your phone near the window and hold it between your body and the window**

When you first switch the phone on or dial out, the phone works at maximum strength. If you are phoning in a strong signal area, after the phone has connected, the power will go down to a level that is only high enough to maintain the connection - this can be HUNDREDS of times lower than the maximum possible power. When you dial the number, after a few seconds it connects to the local network. This is the time of maximum power output.

Vrijheid (2009), in an analysis of 60,000 phone calls that maximum power was used for 39% of the transmission time on the phone call, and the average power output was approximately 50% of the maximum power output of the phones in question.

Buried in the instruction manual of the **iPhone** is a warning to keep it 'at least 15mm away from the body' when making calls or surfing the web. iPhone4 instructions say *" When on a call using the built-in audio receiver in iPhone, hold iPhone with the dock connector pointed down toward your shoulder to increase separation from the antenna … iPhone's SAR measurement may exceed the FCC exposure guidelines for body-worn operation if positioned less than 5/8 inch from the body (e.g. when carrying iPhone in your pocket)."*

The **T-Mobile G1** warns users with pacemakers *"ALWAYS keep the phone more than 6 inches from your pacemaker when the phone is turned ON and you should not carry the phone in a breast pocket and you should use the ear opposite the pacemaker to minimise the potential for interference."*

Motorola: *"Keep the mobile device and its antenna at least 1 inch from your body when transmitting … Using accessories not supplied or approved by Motorola may cause your mobile device to exceed RF energy exposure guidelines."*

Verizon: *"If you are concerned, you may want to limit your own or your children's RF exposure by limiting the length of calls or by using hands-free devices."*

When you switch your mobile phone off completely, you need to hold it away from your body for a few seconds, as it communicates at full power with the network to inform it that the phone is shutting down. This communication takes place when you think it has already stopped working and the screen has gone blank.

- **Hold the phone away from your body when switching it on and immediately after dialling until you hear the person answer**
- **Hold the phone away from your body when, and immediately after, switching it off**

Switching off Blackberrys

Blackberrys do not turn off completely, unless you remove the battery. The warning issued with **Blackberry** handsets goes further. It says people should use the hands-free option or 'keep the

Blackberry device at least 0.98 inches from your body – including the abdomen of pregnant women and the lower abdomen of teenagers' when it is turned on.

Vulnerable areas

Where you carry your phone is also very important. The areas of the body which are most vulnerable to the sort of radio-frequency radiation emitted by mobile phones are:-

- **The eyes**
- **The breasts**
- **The testicles**
- **Kidneys, heart & liver (if the phone is clipped to the trouser belt)**
- **The abdomen of a pregnant woman**

If you do not have a phone pouch:-

Be careful not to hold a phone near or in front of your eyes whilst it is working.

It is important ***not*** to carry a phone in the breast pocket of a blouse, shirt, or jacket. The incidence of both female and male breast cancer is increasing, for reasons as yet unknown. This will place a phone in standby mode (where they regularly wake up and silently chat at full power to the nearest base) too close to the wearer's breasts. Clipping a phone to rucksack straps will radiate you in the same way - put it in a rear rucksack pocket, instead.

An underwired bra may pick up microwave radiation, the metal wire acting as a resonator and amplifying the signal around vulnerable breast tissue. Women should check any underwired bras they have, and choose ones that use stiff non-conductive plastic re-inforcers instead.

Be cautious about using a mobile phone if you wear metal glasses, have metal fillings in your teeth, metal hair accessories, have facial piercing, dental braces, have metal head implants (e.g. following an operation), or have a cochlear implant. One user had two metal pins in his middle ear from an operation. After using a mobile phone he suffered a stroke, and later developed fits. He is sure that the radiation from the phone interacted with the metal pins to create an increased electrical charge, and that this triggered his fits. Joó (2006) found that adults and children using mobile phones who wore metal-rim spectacles or who had metallic implants could be exposed to SARs above the ANSI and IEEE limits. This also applies to people who use crutches, a Zimmer frame or metallic rolling chair.

Carrying a phone clipped on to a belt (on standby, or when using a hands-free kit) is ***not*** a good idea. If you are using a hands-free kit, and you make a call with your phone clipped to your belt, it will be working at a higher power level, because it is generally harder to transmit from waist-height than from head-height. Most phones are clipped to the belt with the control keys and display facing outwards - leaving the antenna pressed against the body, sending high SAR power into the trunk and towards the kidneys and liver. Phones which have antennas hidden in the back of the phone will radiate at the highest level. When it logs in it is almost always at full power and it is internal measurements of the received signal levels of this exchange between handset and base station that sets the future level to be used for calls. This effect has got worse with modern phones and their antennas are more directional in order to lower head SARs when held to the ear in normal use.

Researchers have emphatically stated that mothers-to-be should not expose their growing baby to the emissions from mobile phones, as the baby may not be fully protected by amniotic fluid for extended periods of time due to its natural movements within the womb. The pelvic structure

promotes deep RF radiation penetration and the radiation can be absorbed within the developing embryo or foetus. Cellular changes initiated by mobile phone radiation in the mother also might cross the placental barrier. Pregnant women should never hold a phone (even in standby mode) near their developing baby.

Each time a phone powers up it radiates at full power. Soft tissue and internal organs (kidneys and liver, particularly) are very vulnerable to such radiation. Ovaries are also likely to be susceptible.

Levi Strauss, the US jeans maker launched its S-Fit trousers from its 'Dockers' range, a line of trousers fitted with 'anti-radiation pockets' for mobile phones, aimed at teenagers and 20-somethings, costing as much as £100 a pair. "*Not that we are implying in any way that mobile phones are dangerous*" said Cedric Jungpeter, Levi's European communications manager. Telecoms industry experts accused the firm of cashing in on consumers' fears over mobile handset radiation.

Lady GaGa is concerned about the link between mobile phone usage and the risk of a brain tumour. She insists that whenever she makes a call, one of her team keys the numbers into her phone, then holds it up to her face so when she speaks it isn't too close to her head. She then listens to her calls on the speakerphone.

- **Never hold the phone near your eyes, breasts, testicles, kidneys or liver, or pregnant abdomen**
- **Ideally, keep the phone away from your body (such as in a bag) when it is not in use.**
- **If you have to keep it next to your body, a location such as a rear trouser pocket will help keep it away from major organs.**
- **Try to make sure the antenna is on the outer side.**
- **EMFields phone pouches are an inexpensive way to greatly reduce your radiation exposure - they reduce SARs by over 90%.**

Texting

When a text message is sent, the phone uses maximum power to make the connection. If you hold the phone on your lap to write the text, it is important (especially for boys, due to the vulnerability of testicles to microwaves) to move the phone away from your lap to send the completed message. Generally, it is advisable to hold the phone away from your body after dialling and until the message has been sent.

- **Always hold the phone away from your body to send a text message.**

Standby

When your phone is being used or is on standby, it communicates intermittently with the nearest base station to check the signal strength. If the signal is a weak one, it is likely to contact the base station frequently to try to establish a better signal. As you travel about, the faster and further you move, the more your phone communicates with the network system, making new connections as it needs to change the cell or cluster. These contacts are always at full power. It is important to remember this when travelling in a car or train and to keep the phone away from your body even when it is on standby.

Be careful where you keep a phone on standby. Preferably put it in a bag, or just keep it near you when you are in a building. Do not put a bag with a mobile phone in on the handles of a pushchair near to a child's head.

- **Carry the phone away from your, and anyone else's, body when it is on standby**
- **If you are not imminently expecting a phone call, you can greatly reduce your exposure by having the phone switched off when you carry it around instead of just on standby, as your phone contacts the nearest mast every time you move into a different mast's coverage area, and also checks regularly even when you are stationary - This contact is always made at the phone's full power.**
- **Never carry a mobile phone on standby when travelling except for an emergency and then keep it away from your body**
- **Never have a mobile phone on standby next to your bed during the night. It will log on to the nearest base station at intervals throughout the night exposing you to high levels of RF.**

Other people

Microwave radiation travels through the air (or we couldn't use a phone at all). So if you stand next to a person using their phone, you too will be on the receiving end of a dose of radiation, even if the dose is smaller than the user is exposed to. The closer you sit or stand, the higher the exposure level. We have measured over 6 V/m at the head of passengers in a train sitting in the row ***behind*** the phone user!

- **Never stand, or sit, close to someone else using a phone**

When travelling

Microwave radiation can be both screened by, and reflected from, metal surfaces. It is not a good idea to use a mobile phone, or carry it in standby mode, in a car or train where it is surrounded by metal. You will be on the receiving end of radiation not only from the phone itself, but also reflected off the surrounding metal surfaces. You will also be radiating the people sitting near you. If you are a passenger using a phone in a car, the driver will be exposed to high levels of microwave radiation. In research, using a mobile phone (hands-free or not) is as hazardous as driving over the drink-drive limit (Strayer 2006). It is also linked to memory and concentration problems, so you increase the probability of ending up at the wrong destination, or in an accident! Interestingly, the message is not getting across everywhere. In Iran, 19% of male and 4% of female drivers considered using mobile phones whilst driving not hazardous (Mohammadi 2011).

Some studies (Strayer 2003, 2004, Drews 2008) have reported that, in simulation experiments, those engaged in mobile phone conversations missed twice as many traffic signals as when they were not talking on the phone and took longer to react to those signals that they did detect, and did not habituate to using a phone (Cooper 2008). Most interestingly, there was no difference between hand-held and hands-free mobile phone users. One study Matthews (2003) found that drivers using hands-free phones with external speakers fared worse in an experiment on cognition and became more frustrated than those using a standard mobile, or one with an earpiece. In July 2005 in Perth, Australia, where using a phone while driving has been banned since 2001, the Insurance Institute for Highway Safety reported on their study looking at the phone records of 456 drivers needing hospital treatment after road crashes between 2002 and 2004. The team discovered that *mobile phone use in the 10 minutes before a crash was associated with a four-fold increased likelihood of an accident*, even if a hands-free kit was used. These figures do not include accidents in which the driver did not need hospital treatment. A spokesman for

the Royal Society for the Prevention of Accidents said "*We hope that the people who callously think that their phone call is more important than somebody's life will get the message eventually*".

It is unclear why driving tasks are affected by phone conversations, though recent brain imaging suggests that having a conversation with a remote person uses the same part of the brain that is used to recognise lights and events outside the vehicle. The car driver forms a visual image of the person or context at the end of the phone, which diminishes the ability to be fully aware of the circumstances in which they are driving. This is obviously happening to a certain extent when listening to the radio. However, it is likely that we can 'switch off' the radio, whilst needing to react to an external stimulus, and then switch back. When somebody else, unaware of the circumstances we are coping with, is on the other end of the phone conversation, the switch is not under our control. There may also be neurological effects on concentration and reaction times created by the phone radiation (Esen 2006). The studies done so far indicate little difference between hand-held and hands-free phones. Hands-free phones used inside the car without an aerial external to the car, do expose the driver to significant microwave levels.

One man, in a personal communication, says "*I had an aerial for the handsfree by the window also acting as a tax disc holder (professional handsfree installation). I used to feel a bit ill while driving even with the phone on standby, and thought the aerial might have some part to play. Having moved the aerial to the roof outside, the illness (kind of headache) seems to have disappeared, and the level on the monitor is medium when a call is in progress (was high). I also have a fibreglass bodied car (with glass sunroof) and the levels were high all the time wherever the phone was placed, though I expect the signals bounce off the body etc. The signals from the masts can be picked up while driving past masts at speed on the motorway.*"

It is now illegal to use a hand-held mobile phone whilst driving in the UK.

If you really HAVE to use a phone in a car or on a train or bus, it is best to hold the phone as close as possible to the nearest window. Remember that when the phone is partially screened from the base station (by the car or train body) then it will work at a much higher power than if you used it in the same place but outside the vehicle. In Stockholm, Sweden, a ban on the use of mobile phones on public transport became effective from August 2006. Travellers can only use their phones in designated seats or carriages. There are fines for non-compliance.

- **Never use a mobile phone (or carry it on standby) in a car or train except for an emergency**
- **Do not use any sort of phone whilst driving a car. Pull into the next lay by to make or receive your call, if possible**

Headsets

Dr George Carlo, who led the $25 million WTR research project into mobile phone safety for the telecommunications industry, maintains that if there is a safe way to use a mobile phone at all, it will be using a hands-free kit and holding the phone handset at least 8" away from the body just before, just after and during use.

- **Buy a 'proper' headset, for hands-free use**
- **Your exposure can be greatly reduced by using an air-tube hands-free kit.**

EMFields has two types of hands-free airtube sets. They translate the electrical signals into sounds in a small box, which are then transmitted to and from the ears and mouth by small air pipes like a doctor's stethoscope. There are two types, one with a single earpiece and one with two.

Single earpiece

Double earpieces

- **Always keep the phone away from your body and ensure that the aerial has a clear 'view' of the sky so that it can send and receive easily.**

SARs

SAR actually refers to thermal effects, while the vast majority of the recorded biological effects from man-made non-ionizing environmental radiation are non-thermal. Even if SAR could be accurately estimated for a whole tissue, organ, or body, the biological/health effect is determined by tiny amounts of energy/power absorbed by specific biomolecules, which cannot be calculated. Moreover, it depends upon field parameters not taken into account in SAR calculation. Thus, SAR should not be used as the primary dosimetric quantity, but used only as a complementary measure, always reporting the estimating method and the corresponding error. Radiation/field intensity along with additional physical parameters (such as frequency, modulation etc) which can be directly and in any case more accurately measured on the surface of biological tissues, should constitute the primary measure for EMF exposures, in spite of similar uncertainty to predict the biological effect due to non-linearity (Panagopoulos 2013).

The Specific Absorption Rate (SAR) is a measure in watts of energy absorbed in a certain mass of tissue. ICNIRP set their maximum figure for this in the human head, at 1.6 watts per kg of tissue, measured in 10 grams of tissue selected for the highest exposure when the handset is working at full power, and averaged over 6 minutes - purely to prevent thermal effects. We believe that regular transients (changing and peak levels) may be more harmful than averaged levels. Some phones with very high official SAR values have very efficient antennas and manage to operate at low power, whereas some low peak SAR phones (i) need to operate at higher power and (ii) spread that radiation level over a wider area of the user's head. GSM mobile phones can alter their output radiation power over a range of at least 500:1 whereas full-power SAR values only vary over a range of about 10:1 between phone models. Multiple studies have reported that a short single, two-hour exposure to cell phone radiation will result in pathological leakage of the blood-brain barrier. The effect occurs immediately, and is still seen at 14 days and at 50 days post-exposure at only 0.012 W/Kg. The lowest exposure SARs were worse than the higher SAR exposures (Nittby 2009). These studies show neuron death (brain cells) at very low SARs of only 0.012 W/Kg.

The results of a study by Ghanmi (2014) show that for 5-10% of the studied positions the SAR in the head and the SAR in the brain can be 20% higher than the SAR estimated for the standard cheek position.

Wilén (2003) found that SAR values greater than 0.5 W/kg may be an important factor for the prevalence of some of the symptoms, especially in combination with long calling times per day. The whole-body-averaged specific absorption rate (WBA-SAR) of a female model is higher than that of the male counterpart, mainly because of a thicker subcutaneous fat layer (Sandrini 2004).

A handset with an omnidirectional antenna with a higher gain will be able to transmit at a lower transmitter power, but the EIRP will be the same as the antenna adds the extra gain, so the SAR will be the same. It will save on battery power, but irradiate you just as much. Many handset handbooks contain a safety note saying that they must not be closer to your body (excluding the ear) than between 15 and 25 mm.

It was recommended by the Stewart Report that information about SARs should be provided with every mobile phone bought, making it easier to compare them. SARs are one way of measuring the amount of radiation emitted by the phone. The higher the SAR, the greater the amount of microwaves that may be absorbed by the head. New phones in the UK are forced by law to display SAR levels ***in the manual*** that comes with the phone. Unfortunately, most phones and their accompanying manuals come in blister packs, so you will not have sight of the manual before purchase, *unless you ask to see a copy of the appropriate manual* that shopkeepers have assured us they will have to hand.

The city of San Francisco passed an ordinance in 2010 that requires mobile phone sellers to post SARs prominently.

Using SARs for comparison, German scientists from the Institute for Satellite and Mobile Communication, report that some models of mobile phones expose users to up to 20 times more radiation than others on the market. A difficulty in producing 'league tables' of SARs is that the phone manufacturers bring out new models and old ones become redundant at a quicker rate than the list can be updated and accurate. Dr Gerard Hyland, of Warwick University, one of the foremost researchers into radio-frequency radiation risks to human health, commented that lists of SARs might provide a useful guide to the layman. However, **SARs are taken with the handset operating at full power**, ***taking no account of the efficiency of any given handset***, which can be considerable. In response to low signal strength, an efficient handset powers up less than an inefficient handset, thus exposing the head to lower radiation. Some phones with a *high peak* SAR actually produce lower SARs under normal use conditions than phones with a *low peak* SAR.

SARs cannot be measured directly, only by using sophisticated models and computer mathematical modelling techniques to simulate the radiation from the phones. Although there is progress towards a standard EC (CENELEC) phantom head and measurement protocol, there is no agreed standard method of measurement. Dr Michael Kundi (from the University of Vienna), pointed out in June 2000, that because head tissue is variable in its structure, SARs at higher frequencies would be very different according to the type of tissue simulated. Measurements in phantoms do not accurately reflect these differences and computer simulation would soon face its limits due to accumulation of computation inaccuracies.

Dr Kundi continued by saying that even if only thermal effects were to be considered, long-term exposure might lead to adverse effects. Since energy is deposited at a constant rate, equilibrium can only be maintained by healthy regulatory processes. The mechanisms involved in keeping the temperature at an acceptable level for proper biological functioning could become exhausted, or the strain induced in the system might have some adverse effects in the long run.

SARs are calculated by averaging over time (6 minutes) and volume of tissue (e.g. the USA average over 1 gramme of tissue, the EC over 10 grammes of tissue which usually lowers the apparent SAR to about half the value of the 1 g SAR). Depending on the location of the tissue, and the thermal conductivity of neighbouring tissue and local blood flow, 'maximum SAR' figures can vary over at least a 10-fold range. Complex conditions with intermittent or time-varying exposure are implicitly assumed to have the same effect as a continuous constant exposure of the same average SAR. We know this isn't necessarily true.

Electric fields from mobile phone handsets are in the range 75-300 V/m, but the actual numbers are very variable. A tiny movement (a few mm) of the position of the phone will change the level considerably as the field level depend on the 'loading' your head presents to the signal. Close to your head the magnetic field component (which creates the SAR induced power into your brain) is more important and this does not have a mathematical relationship to the external electric microwave field. Increasing the distance between the user head and antenna decreases SAR values, but an increase in inclination angle does not reduce SAR values in all cases (Hossain 2015). The currents inside the handset from the battery also create several microtesla low-frequency (ELF) magnetic fields throughout your brain. 0.4 microtesla ELF magnetic field is strongly associated with a doubling in childhood leukaemia.

Dr Kundi also reminds us that you can't simply *add* the effects of exposure of the head to different electromagnetic fields (EMFs). Living systems respond in complex ways to multiple exposures. There is no research systematically investigating what happens when living systems are exposed to various EMF sources at the same time. The persistent reports of neurological effects at intensities far lower than anything causing heating, suggest that there are more subtle influences at work. As well as RF radiation, the head is also exposed to ELF magnetic fields from pulsing currents from the phone battery. We don't know what interaction there may be as we have never seen research using computer modelling take the ELF radiation into account.

The World Health Organisation (WHO) believes that until the standard is set, consumers should be cautious about demanding and relying on SAR values for their mobiles. Changes in perception of risk can lead to behavioural change, including being more reckless. It is important that any 'safety' measures taken do not alter the 'use minimally' approach.

- **Buy a phone with a low SAR, but don't rely on that to guarantee your safety**

Antennas

Choose a flap-top phone with a physical antenna sticking up, which is behind the flap when the phone is in use, if possible. The flap provides some screening from the radiation, and also causes the antenna to be positioned at least 1 cm away from the head which greatly reduces the radiation inside the brain of the user.

- **If possible, buy a phone with an external antenna**

Electromagnetic noise

Generated electromagnetic noise can block DNA and other damage of human lens epithelial cells induced by 1800 MHz mobile phone radiation (Wu 2008).

Protective gizmos

There are many 'gizmos' advertised to reduce the emissions from your phone. Those we have measured ***do not do so***. They ***may*** have a beneficial effect on your immune system, which ***may*** then be able to resist the emissions better. There is no scientific way, as yet, of proving this one way or another.

Nine small radiation shields made to adhere to the case of mobile phones were tested at 914 and 1880 MHz by Oliver (2003). Five popular products were tested because advertisements typically claimed they were up to 99% effective in blocking radio frequency (RF) radiation emitted from

mobile phones. The results indicated that the small shields are ineffective in reducing the exposure of the head to RF energy emitted by a mobile phone.

- **Do not rely for your protection on unscientific 'gizmos' or ones that purport to be scientific, unless you have the knowledge to check out their sales propaganda which could be complete garbage. If you wish to use one, use your common sense as well**

Supplements

Ginseng was found to promote the recovery of liver cells after damage by mobile phone RF radiation (Luo 2014). Vitamin E supplementation helped reduce antioxidant damage induced by cell phone RF in pregnant and foetal rats (Gao 2013).