

## Male Infertility Linked to Cell Phone EMF Exposure

By Alasdair Philips - Vol. 12, No. 2. Summer, 2011

Approximately 35% of women and 45% of men worldwide are sub-fertile. About 7% of women and men are effectively infertile [1,2]. Though most men believe infertility is due to “female issues,” the truth is that male infertility plays a role in about 50% of cases of failing to conceive after one year.

Sperm counts in men worldwide have declined by half over the past 50 years and are continuing to fall, according to a number of studies. A 2011 Finnish study of the sperm counts of 858 young men in three birth-year cohorts from the 1970s to the 1980s concluded: “These simultaneous and rapidly occurring adverse trends suggest that the underlying causes are environmental and, as such, preventable.”

The decrease could be due to environmental chemicals affecting early testicular development and/or to increased electromagnetic field (EMF) exposure from cell phones. It is well established that lifestyle factors including smoking and drinking, drugs (medicinal and recreational), hormone-affecting chemicals in our food and environment, and increasing testicular temperature can adversely affect sperm count.



There is growing evidence that EMFs from cell phones can impair male fertility. If the observed association between cell phone EMF exposure and reduced sperm counts proves to be causal, then the dramatic increase in mobile phone use—especially by young people—over the last two decades could be a serious concern.

## RF Damages Spermatozoa

Since the 1940s, researchers have recognized that high-level occupational exposure to radio-frequency (RF) radiation significantly decreases male fertility. More recently, a number of studies have shown that much lower levels of RF radiation, such as that emitted by a cell phone, can also affect sperm quantity and quality. There are also links between RF exposure and effects on female reproductive organs. It is possible that fetuses in utero are susceptible to RF exposure, as well [4].

A very important paper on the effects of cell phone radiation on human sperm in vitro was published by Geoffry De Iuliis and colleagues in 2009 [5]. They found that RF exposure enhances mitochondrial reactive oxygen species around spermatozoa, decreasing both their motility and vitality, while increasing DNA fragmentation. These in vitro findings have clear implications for the safety of long term mobile phone use by males of reproductive age, potentially affecting both their fertility and the health and wellbeing of their offspring.

The De Iuliis paper details the dramatic effect that absorbed RF radiation has on both sperm quality and their ability to move efficiently. The specific absorption rates (SAR) span across the range produced by cell phones in common use. At 1 W/kg, sperm vitality was significantly ( $p < 0.01$ ) decreased from 89% to 65%, and sperm motility reduced from 86% to 68% ( $p < 0.05$ ).



Save the Males: The UK's Electromagnetic Radiation Research Trust recently launched a public education campaign urging men not to carry cell phones in front pockets next to their testicles. These "Save the Male" placards are being posted in public urinals.

What does a 1 W/kg SAR represent? Well, cell phone safety regulations throughout the world permit a maximum allowable SAR of between 1.6 W/kg (USA) and 2 W/kg (most of the world) for cell phones held close to the head.

Higher exposures than this certainly may occur, if the handset is close to other parts of the body. Many phone user manuals now state that the device should be carried at least half an inch away from the body. Eyes, breasts and testicles have electrical characteristics that mean they absorb RF radiation much more highly than any other external part of the human body.

Despite these facts, there are almost no published assessments of likely SAR levels delivered to the testicles from a phone held on the lap whilst texting or carried in a trousers/pants pocket. One theoretical study [6] using the Brooks Air Force Base model of an adult man, predicted up to 4 W/kg peak (in the pulses) with 0.5 W/kg maximum average SAR to the testicles.

### **Potential for Testicular Changes**

Another more recent model [7] using a different type of handset, suggested much lower levels in the region of 0.1 to 0.2 W/kg for an adult male. However, bear in mind that SAR values in a young boy will be higher, as his pocket is closer to his testicles. When dealing with EMF fields, changes as small as 1 mm in the distance between the emitting device and exposed tissue can make a difference in total cumulative absorption.

A study of rats exposed to a SAR of only 0.14 W/kg for 2 hours per day for one month, showed significant adverse changes in their testicles [8]. The diameters of the seminiferous tubules of the testes in the exposed rats were lower than the sham exposure group ( $p < 0.05$ ).

Last year, Nadia Falzone and her colleagues irradiated healthy active human sperm for one hour with a 900 MHz cell phone frequency band at 2 W/kg [9] The radiation caused a halving in sperm head size and an abnormally low level of sperm able to bind with the outer membrane of a human egg. Presumably, this would significantly lower fertility.

Previously, Osman Erogul et al took semen samples from 27 healthy human volunteers, divided each sample, and exposed half of each sample to 5 minutes of RF from an active GSM cell phone at 10 cm distance. They then compared these with the unexposed half-samples [10]. RF exposure caused a statistically significant decrease in forward sperm movement, as well as a reduction in total number of motile sperm.

### **Abnormal Sperm Morphology & Activity**

There have also been a lot of animal studies. Maneesh Mailankot et al exposed male Wistar rats to 1 hour per day of active GSM cell phone radiation for 28 days. They found a significant decrease in sperm movement and activity in samples from the exposed versus non-exposed rats [11].

Adebayo Akeem Otitolaju et al reported significant sperm abnormalities, apparently dose-dependent, in mice exposed to much lower RF levels such as those found near to cell phone base stations [12]. The major abnormalities observed were knobbed, hooked, pin-headed and banana-shaped sperm heads. John Aitken et al found that mice exposed to 900 MHz at 0.09 W/kg for 7 days at 12 h per day showed statistically significant damage to both the mitochondrial genome ( $p < 0.05$ ) and the cell nucleus ( $p < 0.01$ ) [13].

Not all studies have found evidence of harm, however. In a project funded by the German Mobile Phone Health Research Program, Angela Somner and colleagues exposed male and female mice to typical levels of RF radiation from 3G/UMTS cell phones [14]. Their study did not find harmful effects of long-term exposure over several generations of mice. This study is an exception to the clear trend in almost all other studies of RF radiation and fertility.

### **Cause for Concern**

The evidence that radiation from cell phones affects sperm quantity and quality in humans and animals is compelling. The key clinical question is whether this translates into declines in actual human fertility? Though this has not been definitively proven, two recent studies are cause for serious concern.

Ashok Agarwal et al studied 361 men attending an infertility clinic. They were divided into four groups according to their active cell phone use: no cell phone use; 0-2 hours per day; 2-4 hours per day; and over 4 hours per day [15]. The comparisons of mean sperm count, motility, viability, and

normal sperm morphology among the four groups showed statistically significant inverse correlations.

Basically, the men with the highest cell phone use had the lowest semen quality. Importantly, the decrease in sperm parameters was dependent on the duration of daily exposure to cell phones. Note that though the correlation was with "cell phone use," the likely cause was direct testicular exposure from where the phone was carried and how it was used. In a given case, was the man holding the unit to his head or using a hands-free headset whilst carrying the phone in a pocket? This needs further investigation.

Another study, by Artur Wdowiak et al, looked at 304 males undergoing infertility therapy; 99 of them did not use a cell phone. They found an increase abnormal sperm morphology associated with the duration of RF exposure from GSM phones[16]. They also found that these sperm were less likely to fertilize an egg due to lack of vitality and movement; this also correlated with cumulative cell phone use.

Single short-term exposure effects usually only last for a few days. However no work has been done on whether chronic long-term exposure may cause permanent effects on male fertility.

### **Power-Frequency EMF Effects**

Men exposed to magnetic fields of only 0.16 microtesla ( $\mu\text{T}$ ) in strength for six or more hours per day are four times as likely to have substandard sperm [17]. DNA breaks and sperm chromatin changes have been found experimentally, when sperm is exposed to low frequency EMFs [18]; these changes would clearly predict infertility [19].

Animal studies corroborate this. Researchers have observed compromised sperm function in boars and rabbits, leading to a reduction in fertilization rate, when the animals or their sperm are exposed to low frequency EMFs [20,21].

Cell apoptosis has been seen in mouse testicular germ cells as a result of exposure to  $14\mu\text{T}$  60 Hz magnetic fields[22]. This is significantly above typical chronic background exposure (less than about  $0.2\ \mu\text{T}$ ), but is well below the international guidance levels for human exposure. Many of us are exposed to EMF fields above  $14\mu\text{T}$  on most days. These testicular germ cell changes can occur at even lower EMF levels [23]. Testicle tissue is almost certainly damaged by long-term exposure to ELF electromagnetic fields [24], and testicular developmental delay or degeneration can also occur after maternal exposure during pregnancy or the early postnatal period [25,26]

Testicular cancer is on the rise around the world for unknown reasons, especially in younger men. There may be a connection with RF exposure, but the data are far from clear on this. A 2010 review of EMF/RF exposures and testicular cancer found three studies showing no effect, two reporting a significant increase, and four showing a non-significant increase in incidence [27].

### **Increased Risk of Miscarriage?**

Little is known about the direct effects of RF exposure on female fertility. Rat studies suggest adverse impact, but so far we only have data about exposure levels representative of high-level occupational exposure, not everyday EMF exposures [28]. Chick mortality is increased as a result of RF exposure [29] but the mechanism for the biological changes in animals have not yet been identified [30], and it is difficult to draw human conclusions from these studies.

What we do know is that there seems to be increased incidence of human miscarriages correlating with EMF exposure. There were highly significant numbers of miscarriages documented near two different high-voltage powerlines in Stoke on Trent [30,31]. The association was especially strong where there were high 'transient' fields, that is, where field levels changed rapidly in a short period of time. An exposure of only 1.6  $\mu$ T (16 mG) was associated with a doubling in spontaneous abortion rate, especially in the first trimester.

Locations where this type of exposure to high transient EMFs can occur include electric trains and trams, some cars, anti-theft (EAS) pillars at large shop doorways, some library security reader/writers and working microwave ovens.

Researchers have documented changes in the ovary and uterus after exposure to EMFs for over 50 days [32]. Experiments with mice showed that low frequency EMF exposure had some adverse effects on reproduction, including miscarriage, fetal loss and malformation and developmental delay in the offspring [33,34]. While we can't draw definitive conclusions that the same thing is happening in humans, these data do raise a red flag.

### **Recommendation for Protection**

Unfortunately, existing public safety guidelines for EMF/RF-emitting devices are inadequate because they only protect against electric shocks and acute EMF exposure at sufficient levels to generate heat in bodily tissues. None of the guidelines currently mandated by governments worldwide will safeguard against other EMF effects at lower exposure levels.

In the absence of stringent safety regulations, and in light of the growing evidence of significant biological effects, including possible deleterious impact on fertility, it is essential that people learn how to protect themselves and minimize risk. Physicians can play a vital role in helping them understand how to do so.

Here are steps people can take to reduce their EMF exposure that may help preserve their fertility:

- Do not carry a cell phone in the trouser pockets when the phone is on standby or when using a hands-free kit.
- Do not text holding the phone at waist level.
- Avoid using a laptop computer on your lap, as this exposes the reproductive organs to heat from the fan, as well as RF and low frequency EMF from the electronics and power supply. The combination may adversely affect testicular tissue and sperm quality in men; might affect the growing fetus in pregnant women, and possibly the ovaries and uteri in all women.
- Minimize sources of RF at home. People should ask themselves if they truly need such things as DECT phones, WiFi (they can use a wired network or a dLAN network), and wireless game consoles, baby monitors, or burglar alarms. Remember, “wireless” equals increased RF/EMF exposure.
- Consider workplace exposure. Always ask patients what equipment they sit near or work with on a daily basis. If a patient has concerns, encourage him/her to ask the employer for a formal EMF/RF assessment. Often, a simple office re-arrangement can dramatically reduce exposure.
- Women with histories of miscarriage should minimize RF/EMF exposure as much as practically possible.
- “Smart cars” spell trouble. The more complex a person’s automobile, the more RF exposure they—and their children—are getting. Cars with the engine at the front and the battery in the trunk have particularly high EMF levels inside.

- Pregnant women should avoid standing very close to appliances such as washing machines, electric cookers and microwave ovens whilst they are running.

To learn more ways to minimize risks from wireless devices, read our online-only feature on “EMF Hygiene” by Camilla Rees, author of “Public Health SOS: The Shadow Side of the Wireless Revolution.”

Alasdair Philips is qualified in both Electrical and Electronic Engineering and in Agricultural Engineering. He is co-founder and director of Powerwatch UK, a watchdog organization that, since the 1980s has served as a forum for a small group of knowledgeable engineers and scientists concerned about potentially hazardous biological effects of EMF exposure.

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