Mobile Phones and Male Fertility

Several research studies from fertility clinics around the world have claimed to have observed effects associated with mobile phones on various markers of male fertility including sperm count, vitality, motility and morphology. However, many of these studies have significant flaws in their design or analysis. In particular, they often fail to account for lifestyle factors such as stress, diet and obesity, smoking and alcohol which are widely thought to be linked to male fertility but may be also associated with mobile phone use and therefore confound the findings of these studies. No studies have been able to provide any direct evidence of a mechanism for purported effects, and together with the general poor quality of the studies and inconsistent results, the overall body of evidence on the effects of mobile phone use on male fertility does not allow any firm conclusions to be drawn.

What do we know about male fertility?

Some reviews have indicated that male fertility has declined in recent decades[1] and claims of substantial reductions in sperm count are controversial.[21] It is estimated that 15-20% of couples are clinically infertile (often defined as attempting to conceive a child unsuccessfully for more than one year) and that the male factor is the cause in more than 50% of these cases.[2] Lifestyle factors including tobacco, alcohol, caffeine, illicit drugs and related conditions such as hypertension, obesity, cardiovascular disease and diabetes have all been linked with reduced fertility in both genders.[3]

How is male fertility defined?

A range of markers are used to describe male fertility, including sperm count (or concentration), vitality (*the number of alive sperm*), motility (*the number of progressively moving sperm*) and morphology (*the number of 'normal looking' sperm*). The World Health Organization (WHO) defines a standard description of these markers and others for objective assessments of fertility[4] but interpretations and methods used by researchers are highly variable. This adds to the uncertainty of the findings from studies on fertility, including those related to mobile phones, either in regard to use or radiofrequency (RF) exposure.

What studies have been undertaken?
Exposure to lifestyle factors such as those mentioned above and environmental agents such as water or air pollution and pesticides have been the topics of previous investigations.[5] Some studies have now begun investigating mobile phone use as another potential cause. These studies fall into three main categories:

i. *human studies* investigating the fertility in subjects either recruited especially for the study or who were already attending infertility clinics for treatment and who use mobile phones;

ii. *animal studies* investigating fertility in animals, usually rats or mice, which are exposed to mobile phone type signals in a laboratory setting;

iii. *in vitro studies* where human sperm in a test tube or similar flask is exposed directly to mobile phone type signals in a laboratory setting.

What did the studies find?
Several studies in each of these categories have reported effects on fertility from RF exposure from mobile phones or mobile phone use:

(i) Human Studies: Studies at fertility clinics in the US[6], Hungary[7], Poland[2], Singapore[8] and Austria[9] reported no significant effects from mobile phone exposure on sperm count overall, and inconsistent or non-significant effects on other markers of fertility such as vitality, motility and morphology. Problems with these studies include subject selection from a fertility clinic since they may not represent the general population; small subject numbers; poor control for many confounding lifestyle factors (previously mentioned) and; very poor exposure assessment (mostly self reported phone use), which for typical use results in very little RF exposure to the testes and is therefore a poor metric even if accurately recalled.

(ii) Animal Studies: Animal studies from Australia[10], Turkey[11] and India[12,13] have been inconsistent in their findings. The Australian study reports indicators of DNA (genetic) damage in only one of three assays conducted, while the two Indian studies report numerous effects on a wide range of fertility and reproductive outcomes. All studies suffer from using too few animals (as little as 16), too many endpoints (increasing chance findings), and poor exposure design, control and RF dosimetry analysis (including using a mobile phone handset operating normally off a network with no exposure assessment). A larger (but not large, n=40) study from Korea with an otherwise sound study design found no effects on a range of fertility markers in rats exposed to simulated mobile phone signals under well controlled conditions.[14]

(iii) *In vitro* Studies: Studies from South Africa[15], Australia[16], and the US[17], two presented as only pilot studies, have reported inconsistent effects on human sperm exposed to simulated or actual mobile phone signals. The most significant effects are found in the Australian study, but only at unrealistically high exposures (up to 27.5 W/kg estimated), especially in regard to the testes which are likely to receive very low exposures in normal use. It is not clear that temperature rise, to which human sperm is known to be sensitive, was properly controlled during these exposures. Poor exposure design, control and assessment remains a common factor with these studies. Overall, the literature is too sparse and of insufficient quality to enable a conclusion to be drawn from this line of research.

Other technology factors

Other factors of modern lifestyles and technology that have been explored by researchers include sedentary occupations (sitting) and laptop computer use.[5,18,19] Long periods of sitting were found to cause increases in scrotal temperature which were associated with reduced sperm count. The effect was exacerbated by use of laptop computers, most significantly due to impaired cooling of the testes owing to the posture adopted when the device is on the lap.

Comment on the current evidence

Although many of the studies report some effects of mobile phone or other RF exposure on fertility in men, overall the literature in this area is so sparse, and the findings too inconsistent for a clear conclusion to be drawn. Study design is usually poor, using too few subjects or animals, with inadequate exposure design and control, too many comparisons for reliable hypothesis testing, and inadequate consideration of potential confounders.

Reviews

A recent review of environmental factors affecting semen quality concluded in relation to mobile phones:[1]

The results of the presented studies provide limited support to the hypothesis that use of mobile phones may adversely affect semen quality, but most of the presented studies are small….so there is a need for future studies is this area.'

The International Commission on Non-Ionising Radiation Protections (ICNIRP) comment in their recent review of RF health effects that:[20]

'Overall, problems of exposure assessment temper any conclusions regarding reproductive outcomes, and no adverse effects of RF have been substantiated.'

References:

1 Jurewicz et al 2009, Int J Occ Med & Env. Health; **2** Wdowiak et al 2007, An of Agric Environ Med; **3** Kumar et al 2009, Indian J Experimental Biology; **4** WHO 1999, Cambridge University Press UK; **5** Sharpe 2010, Phil Trans R Soc B; **6** Argarwal et al 2007, Fertility & Sterility; **7** Fejes et al 2005, Arch. of Andrology; **8** Chia et al 2001, J Occ & Env. Med; **9** Gutschi et al 2011, Andrologia; **10** Aitken et al 2005, Int J Andrology; **11** Dasdag et al 2003, Bioelectromagnetics; **12** Kumar et al 2008, Conf on Microwave 08; **13** Kumar et al 2010, Indian J Experimental Biol; **14** Lee et al 2003, Bioelectromagnetics; **15** Falzone et al 2010, Rad Res; **16** de Iuliius et al 2010, PLoS ONE; **17** Argarwal et al 2009, Fertility & Sterility; **18** Sheynkin et al 2005, Human Reproduction; **19** Sheynkin et al 2005, Fertility & Sterility; **20** ICNIRP 2009, (Available at http://www.icnirp.de/documents/RFReview.pdf); **21** Bonde et al 2011, Epidemiology.

Where to go for more information

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