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Review Article

Effect of mobile telephony on male reproduction: a review

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ABSTRACT

Mobile telephony is not very old phenomenon, it functions based on electro-magnetic-radiation (EMR). Mobile telephony has eased the communication. Almost ninety percent work are done using mobile telephony. Therefore, use and users of mobile telephony are increasing rapidly and significantly daily. Recently, some published research studies show that mobile telephony affects the human health and reproductive system too. Percentage of cancer and tumor cases have also enhanced significantly all over the world. In animal it is well established that electro-magnetic radiation (EMR) affects male reproductive system and fertility. Articles being published recently also suggested that over-use of mobile telephony affects the semen profile of human. But contrary to this, some researchers have claimed that mobile telephony does not adversely affect the human male reproductive system. Therefore, this article reviews all important published research studies on effect of mobile telephony on male reproductive system and future direction to fight this invisible environmental pollution (if it is really affecting).

Keyword: Mobile telephony, Male reproductive system

INTRODUCTION

Mobile telephony refers to the communication technology that enables wireless voice and data transmission using mobile devices, such as smart phones. It relies on cellular networks to facilitate portable and convenient connectivity. Mobile phones are sometimes called cellular phones are very useful integral part of our daily life for communication. It has eased the mode of telecommunication and overcome the problem of communication between moving individuals.

Recently mobile phone users are rapidly increasing in worldwide. 6.8 billion mobile subscribers worldwide.¹ This number is growing rapidly and significantly. Most parts of the world they are only reliable and easy way for communication. Mobile phones functioning based on electro-magnetic radiation (EMR). Radiation is a

combination of electrical and magnetic energy which travels through space at the speed of light. It is also called as electro-magnetic radiation (EMR). Radiation is categorized into following manner:

Ionizing radiation

It is capable of causing characteristics changes in atoms or molecules in the body which can results in to tissue damages such as cancer, tumors, etc. X-rays, alpha, beta and gamma rays are examples of such potentially harmful electromagnetic radiations.

Ionizing radiation are use in medical imaging (X-rays), cancer treatment (radiotherapy), industrial processes (radiography), and scientific research. It is used in materials, sterilized medical equipment, and study of atomic structures.

Non-ionizing radiation

These kinds of radiations do not cause above mentioned damages but they can cause molecule to vibrate. This can cause local heating and other secondary effects. Examples of non-ionizing radiations are low frequency UV (ultra-violet radiations) rays, visible light, infra-red radiations, micro-wave and radio-wave. Non-ionizing radiation are used in medical diagnostics (MRI), telecommunications (microwaves, radio waves), and cooking (microwave ovens). It also plays role in technologies like radar and infrared sensing.

FUNCTIONING OF MOBILE TELEPHONY

The mobile phones work like a two-way radio and include the individual hand set and the base station. Base stations have their antennae mounted high off ground to get widest coverage. A mobile phone has a radio-receiver and transmitter. When person makes a call, his phone uses radio-frequency (RF) radiation via its antenna to talk to nearby station. Once the base station has received users signal, his call is routed through the land-line phone system.

These phones and laptop emit electromagnetic radiation, which are reported to be harmful for human health. Use of mobile phone affects the semen volume, semen viscosity, sperm morphology, sperm count, sperm viability, leaky plasma membrane, calcium depletion and increasing abnormal sperm cell count, oxidative stress, heating and alters hormonal level.¹⁻⁹

ELECTRO-MAGNETIC-RADIATION (EMR) AND ITS EFFECTS ON REPRODUCTIVE SYSTEM (ANIMAL STUDIES)

Effects on testes

According to Hammodi, show that exposure of 900MHz radiofrequency of mobile phone reduced the weight of testes following 1hour/day exposure for 30 days.¹¹ Exposure to 2.45 GHz RFR decreased the diameter of seminiferous tubules and also thickness of tunica albuginea. Studies of Al-Saedi et al, in rabbits also showed degradation in the seminiferous tubules and the disappearance of spermatozoa.¹¹ Exposure to 4G-LTE mobile phone/2.45 GHz electromagnetic radiation caused decrease in number of leydig cells and thus affected spermatogenesis and resulted in apoptosis in male Wistar rats.^{12,13} Similar results showed by Shokri et al.¹⁴

Long term exposure causes oxidative stress and oxidative DNA damage in rat testicular tissue and may generate single-strand DNA, malondialdehyde (MDA) significantly increased in exposure group while the testicular antioxidant superoxide dismutase (SOD) and glutathione peroxidase (GPx) activity showed a significant decrease in comparison to control group.^{15,16} While some other studies done in rats shows that exposure to mobile phone EMR

were not having any effect on the weight of testes, diameter of seminiferous tubules and histological appearance of seminiferous tubules.¹⁶⁻¹⁹

Effects on epididymis

Studies of Dasdag et al, show that exposure of EMR (2.45 GHz) reduced the weight of epididymis following the exposure of 24 hours/day for a year.¹⁵ Studies being done by Erdemli et al, showed the exposure of EMR (2100 MHz) caused structural changes in ductus epididymis tissue, and sperm density also reduced in lumen. Contrary to these studies, Tas et al, shows that exposure of mobile phone 900 MHz was not having any effect on weight of epididymis of Wistar Male rats.^{17,18}

Effects on seminal vesicle

Recent studies revealed that exposure of EMR (2.45 GHz) reduce the weight of seminal vesicle in Wister rats.^{14,20} However, according to another study the exposure of EMR (900 MHz) increases the weight of seminal vesicle in Wistar rats when exposed to 2 hours/day for one month.¹⁰

Effects on prostate gland

Studies done by Khaki et al, in rats showed that the exposure of EMR (50 Hz) affected prostate gland histology like irregular smooth muscle fiber, prostate capsule thinner in some part, secretory epithelial cells inactive and cuboidal and their nuclei were dense.²² Research studies being done by Hammodi, showed the exposure of EMR (900 MHz 1h and 2 hours/day for 30 days) decreased the weight of prostate gland in male Wistar rats.¹⁰ Contrary to above mentioned studies, Tas et al, shows in rats that exposure of mobile phone (900 MHz EMR) was not having any effect on weight of prostate gland.¹⁸

Effects on sperm quality

Exposure of mobile phone (EMR) decreased the total sperm count, living sperm cells and increased the percentage of abnormal sperm, sperm viability, motility, total antioxidant capacity, spermatogonia, spermatids and spermatogenesis. It also affected sperm head and caused significant changes in sperm morphology.^{10,13,20,23,24} Research study done by Tas et al, show that exposure to mobile phone 900 MHz EMR was not affecting epididymal sperm concentration and sperm motility.¹⁸ Study done by Yaseen, in rats where mobile phone (EMR) exposure being in standing mode did not have any effects on sperm concentration and sperm morphology.²⁴

Effects on LH, FSH and testosterone

Some researches being done in rat shows that exposure of mobile phone radiation/2100 MHz RFR reduced the serum testosterone level, follicle stimulating hormone and luteinising hormone.^{11,16,25-27} Contrary above studies,

Nisbet et al, shows that exposure to EMF 1800 MHz and 900 MHz increased the serum testosterone level in male Albino Wistar rats following exposure of 2 hours/day for 90 days.¹⁸

ELECTRO-MAGNETIC RADIATION AND ITS EFFECTS ON HUMAN

Semen profile

Researches being done by various researchers show that exposure of mobile phone (EMR 900 MHz/1800 MHz/Wi-Fi 2.45 GHz RFR) increased the abnormal sperm cells in the semen sample and decreased the sperm motility sperm count, affected sperm morphology and sperm viability.^{6,31,33-35} According to Al-Bayyari, who conducted a study on 159 human male volunteers showed that exposure to EMR affected the sperm concentration, volume, viscosity and liquefaction time and sperm morphology and increased the immotile sperms in semen sample.⁵ Some researchers reviewed that exposure of micro-wave/wi-fi/ mobile phone radiation affected sperm quality and viability their motility, morphology, count, leaky plasma membranes, calcium depletion and oxidative stress.^{2,3} Review article of Darvish et al, showed that the exposure to EMR affected the sperm motility, sperm viability, sperm morphology, volume, sperm density, and sperm fertility.¹⁹

Some other researchers show that exposure of mobile phone/microwave/laptop and wi-fi increased DNA fragmentation, elevated reactive oxygen species ROS, disrupted protein kinases and oxidative enzymes, induce oxidative stress, decreased serum testosterone level and increased LH level in the serum also caused degeneration in the seminiferous tubules, spermatogonia apoptosis, decreased in the height of germinal epithelium and the number of leydig cells.^{4,6-8,31,35,36} On the other hand, Chalabi et al, shows that exposure of mobile phone EMR did not have any effect on serum testosterone level (this study was done in 300 infertile patients). Whereas Wdowiak et al, 2018 showed that of exposure to 43 KHz RFR increased percentages of sperm in progressive motility in 103 fertile healthy males.^{11,37}

CONCLUSION

It is very clear from above studies and discussion that electro-magnetic-radiation [EMR] affects the human body and reproductive health in a dose and exposure duration dependent manner. Mobile telephony is not very old phenomenon but use and users have enhanced drastically. Recently further research studies needed pertaining to the possible effect of mobile telephony on human health with emphasis on reproduction process.

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