Chapter 13

Effects of Radiofrequency Radiations on the Male Reproductive System

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Abstract

With the advancement of technology, many electronic devices enter our lives and we interact with them for a long time. It is a matter of curiosity what kind of effect the frequency bands, which increase with the advancement of mobile phone technology generations, have on humans. In our study, we aimed to investigate the reports regarding the effects of waves emitting radiofrequency radiation in different frequency bands on the male reproductive system.

In our study, scanning was carried out by using search engines such as Pubmed and Google Scholar and typing the keywords "900 MHz, 1800 MHz, 2100 MHz, 2.45 GHz, male reproduction".

It is seen that scientific studies are mostly carried out in the 900 MHz and 2.45 GHz frequency bands. It appears that less work has been done with 2100 MHz. The study findings show that the radiofrequency radiation given by the phones that have recently entered our lives has negative effects on the male reproductive system. These effects have been reported to contribute to infertility, such as deterioration of sperm morphology and sperm motility.

As a result, it is seen that all frequency bands can have negative effects on the male reproductive system and in this respect, keeping these devices away from the pelvic area is very important for reproductive health.

Introduction

Since radiofrequency electromagnetic radiations cannot be seen, heard or smelled, it has always aroused curiosity about what kind of effects they have as a result of long exposure. Reports on the possible effects of these areas are published in the scientific community regarding their biological

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https://doi.org/10.58830/ozgur.pub384.c1680

effects on public health. In our study, especially experimental studies have been compiled and all data (positive or negative) of the results of all studies conducted to date have been presented.

Effect of 900 MHz radiofrequency radiation on the male reproductive system

It has been reported that 20 minutes of daily mobile phone exposure causes a decrease in the sperm amount and significant changes in sperm shapes of male albino mice (Yaseen, 2022). In another study, the testosterone level of the experimental group rats was found to be significantly lower than the control group after 900 MHz radiofrequency electromagnetic field (30 minutes of exposure for 4 weeks) (Koyu et al., 2009). Researchers exposed rats to 900 MHz radiation for 3 hours a day for a year. In the study, no difference was observed in sperm motility and concentration of the exposure group rats (Taş et al., 2014). In another study, it was reported that 900 MHz RF electromagnetic field could cause oxidative stress in the testicles of rats and that this situation was quite low for testicular damage (Gür et al., 2021). They stated that 900 MHz RF-EMF exposure for 20 minutes a day for three weeks may cause oxidative damage to the testicular tissue by affecting the antioxidant defense system (Eşmekaya et al., 2011). It has been reported that Swiss male mice exposed to RF (900 MHz) for 4 hours and 8 hours a day for 35 days caused DNA damage in the germ cells, causing low sperm count (Pandey et al., 2017). Researchers performing proteomic analysis of continuous 900 MHz (1, 2, and 4 hours of daily exposure) radiofrequency electromagnetic field exposure in testicular tissue showed that RF-EMF exposure causes increases in testicular proteins in adults that are associated with carcinogenic risk and reproductive damage (Sepehrimanesh et al., 2017). It has been reported that exposure to 900 MHz for fifty days and two hours a day causes a significant increase in the rate of apoptotic sperm cells (Liu et al., 2014).

Effect of 1800 MHz radiofrequency radiation on the male reproductive system

In the study, the effects of exposure to adult male Sprague-Dawley rats (32 days, 2 hours a day) on reproductive functional markers were investigated. As a result of the study, it is stated that it may cause a decrease in testosterone levels, a decrease in daily sperm production and sperm motility, and adverse effects on male reproductive function (Qin et al., 2014). It has been emphasized that 1800 MHz RF radiation exposure for 1 hour a day for thirty days may cause damage to the testicular tissue, and exposure-

related damage may be associated with infertility (Demirbağ et al., 2023). Researchers have investigated the possible effects of 1800 MHz GSM-like radiation on the whole body on male fertility. They did not find any difference in Leydig cells (Forgacs et al., 2006). In another study, pro and anti-apoptotic proteins were investigated to check whether exposure for 3 hours a day for 120 days made any changes in testicular tissue. The result of the study was that oxidative stress could disrupt testicular function (Shahin et al., 2018). In another study, they reported that 1800 MHz exposure may cause oxidative damage in testicular tissue (Özorak et al., 2013). They reported that 1800 MHz radiofrequency exposure applied for 2 hours a day and for 90 days on Wistar albino rats could cause an increase in testosterone levels (Nisbet et al., 2012).

Effect of 2100 MHz radiofrequency radiation on the male reproductive system

Researchers investigating the effect of 2100 MHz Radiofrequency radiation on ductus epididymis tissue in rats did not observe any significant change with exposure as a result of the study (Erdemli et al., 2015). They reported that 2100 MHz RF-radiation exposure for 60 minutes daily, 5 days a week for eight weeks, may cause an oxidative increase in the testicular tissue of male Wistar albino rats and that this effect may affect the male reproductive system (Kuzay et al., 2021). As the rate of mobile phone usage increases, its effects on health continue to be investigated. Researchers state that 3G mobile phone exposure for 2 hours a day for 45 days may change the fertility and sperm parameters of Wistar male rats (Gautam et al., 2017).

Effect of 2.45 GHz radiofrequency radiation on the male reproductive system

They stated that 2450 MHz electromagnetic field may cause a decrease in testosterone levels on reproductive hormones in rats (Saygın et al., 2009). They showed that exposure to 2.4 GHz RFR radiation for 24 h/day for 12 months (1 year) could affect some reproductive parameters of male rats (Daşdağ et al., 2015). There are research reports showing that prenatal exposure to microwave radiation has a negative effect on postnatal testicular development in rats (Andrašková et al., 2022). It has been reported that there is a dose-dependent effect on the evaluation of lipid peroxidation levels and histology in prepubertal male rat testicular tissue in rats exposed to 2.45 GHz RF radiation at different electric field intensities (Karadayı et al., 2023). Researchers investigated the effect of 2.45 GHz microwave radiation at low doses (1 hour per day for 30 days) on testicular damage. As a result, it has

been reported that testicular damage occurs and may have a negative impact on male reproductive system function (Bilgici et al., 2018). In another study, continuous 2-hour exposure was established for 35 days. It has been stated that chronic exposure may cause the formation of apoptotic cells in the testicles (Kesari et al., 2010). In another study, 2.45 GHz Wi-Fi radiation for 7 hours a day for 2 months increased the number of apoptosis-positive cells and caspase-3 activity in the seminiferous tubules of rats (Shokri et al., 2015). It was investigated what kind of effect 2.45 GHz exposure had on male Wistar rats. As a result of the study, it was reported that it caused a decrease in the number of Leydig cells and an increase in the number of apoptosis-positive cells in the seminiferous tubules (Saygin et al., 2011). Some studies have stated that exposure to similar doses does not cause any abnormalities in sperm motility and morphology (Imai et al., 2011).

In Conclusion

It is seen that there are many scientific study results at different frequencies, different doses and durations. Looking at the experimental studies conducted at different frequencies, some study reports were that they could cause damage, while others could not. Therefore, more detailed studies are needed. It is important that studies can be repeated at the same doses and durations and yield the same results. Therefore, we can state that it is important to create a similar exposure model for studies in this respect.

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