Source: UC Berkeley School of Public Health
https://www.saferemr.com/2014/03/is-cell-phone-radiation-risk-factor-for.html

Tuesday, November 7, 2023

Female Infertility & Cell Phone Radiation

Although we have considerable evidence that cell phone radiation damages sperm and is associated with male infertility, little attention has been paid to studying the effects of cell phone radiation on female infertility.*

A study by Courtney Lynch and her colleagues found for women trying to get pregnant that stress as measured by the alpha-amylase levels in their saliva predicted whether they were successful. The researchers found that women with the highest levels of this enzyme in their saliva had a 29 percent lower probability of pregnancy compared to those with the lowest levels.

Although this study did not examine electromagnetic field (EMF) exposure, earlier research published by Christoph Augner and his colleagues found that people who lived within 100 meters of cell phone towers had greater salivary alpha-amylase levels. In an experimental study, the researchers found that exposure to higher levels of GSM cell tower radiation increased the levels of this salivary enzyme.

In a 2013 review paper, Nazıroğlu and colleagues examined research on the effects of Wi-Fi and mobile phone radiation on reproductive signaling pathways. They reported that this radiation is related to "oxidative stress and overproduction of free oxygen radicals in female and male infertility." The authors concluded that "the role of EMR from mobile phones and wireless devices in female and male fertility should be investigated."

A 2023 systematic review and meta-analysis of six studies found that the risk of miscarriage was 1.69 times higher in pregnant women who were exposed to "high levels" of powerline and/or radio frequency EMF than the risk for those not exposed to higher levels of EMF.

References (Last update: 11/7/2023)

Electromagnetic Field Exposure and (Spontaneous) Abortion in Pregnant Women: A Systematic Review and Meta-Analysis

Irani M, Aradmehr M, Ghorbani M, Baghani R. Electromagnetic Field Exposure and Abortion in Pregnant Women: A Systematic Review and Meta-Analysis. *Malays J Med Sci*. 2023;30(5):70-80. doi:10.21315/mjms2023.30.5.6

Abstract

This study examined the effects of exposure to electromagnetic fields (EMF) on pregnancy and the risk of miscarriage. We performed a systematic search for relevant studies published to August 2021 in the medical databases of PubMed, CINAHL, Scopus, Web of Science, Google Scholar and Cochrane Library. The following key terms were used: 'electromagnetic field,' 'mobile phones,' 'mobile phone base stations,' 'watching TV,' 'using Internet,' 'miscarriage,' 'abortions,' 'spontaneous abortion,' 'early abortion' and 'late abortion'. All case–control and cohort studies that investigated the effect of EMF exposure on the risk of miscarriage were included without any restriction of language or time. Statistical analyses were done using Comprehensive Meta-Analysis software (version 2.0). A random-effects model was performed to calculate the overall effect size. A primary search revealed a total of 982 relevant studies; six articles (N = 3,187 participants) met the inclusion criteria for the meta-analysis. The results of the random-

effects meta-analysis indicated that EMF exposure had a significant effect on miscarriage: rate ratio (RR) = 1.699; 95% confidence interval (CI): 1.121, 2.363 ($P < 0.001$); and heterogeneity (I^2) = 84.55% ($P < 0.001$). The findings showed that pregnant women who were exposed to high levels of EMF had an increased risk of miscarriage.

Excerpts

This systematic review and meta-analysis study was performed to investigate the effects that exposure to EMF during pregnancy had on the risk of spontaneous abortion. Six articles were included in the meta-analysis; five studies confirmed the effect of exposure to electromagnetic waves on spontaneous abortion (25–30). The study by Abad et al. (27) indicated that, although women who were exposed to significant levels of electromagnetic waves had a high risk of miscarriage, the relationship was not confirmed by the Wald test. The lack of evidence may have been related to the small sample size of the study (27).

The present meta-analysis study showed that the risk of miscarriage in pregnant women who were exposed to EMF was 1.69 times higher than the risk for women who were not exposed. Ebadi et al. (31) showed that there was a significant relationship between exposure to low-frequency EMF (i.e. 3 Hz–3000 Hz) generated from sources in the home and the risk of miscarriage in pregnant women at < 14 weeks gestation. The researchers also found that the duration of mobile phone use during the day and the intervals between mobile phone use were associated with the risk of miscarriage (31).

... Different studies have reported conflicting results in terms of the duration of exposure and the risk of abortion. For example, Li et al. (28) found strong evidence that exposure to a magnetic field over 16 mG may be associated with a risk of miscarriage. Their study showed that the RR associated with a magnetic field exposure of 16 mG was 2.2 (95% CI: 1.2, 4.0). The researchers also showed that the risk of miscarriage from exposure to magnetic waves was greater in early pregnancy (< 10 weeks) because the foetus was more sensitive to environmental factors (28).

In their case–control study, Lee et al. (29) found that exposure to high and frequent magnetic fields increased the risk of abortion in pregnant women enrolled in a medical care system in Northern California. The researchers stated that the risk of abortion increased with exposures above the 50th percentile level in the environment (29). In another study, researchers looked at mobile phone use and the risk of abortion in two groups of women: the case group of women had a spontaneous abortion at < 14 weeks and the control group of women were > 14 weeks gestation. They found that the average duration of mobile phone contact during the day, the location of the phone when not in use, the use of the phone for other applications, the specific absorption rate (SAR) and the mean effective SAR were significantly different between the two groups (26).
Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10624444/

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The role of non-ionizing electromagnetic radiation on female fertility: A review

Pooja Jangid, Umesh Rai, Radhey Shyam Sharma, Rajeev Singh. The role of non-ionizing electromagnetic radiation on female fertility: A review. Int J Environ Health Res. 2022 Feb 8;1-16. doi: 10.1080/09603123.2022.2030676.

Abstract

With increasing technological developments, exposure to non-ionizing radiation has become unavoidable as people cannot escape from electromagnetic field sources, such as Wi-Fi, electric wires, microwave oven, radio, telecommunication, bluetooth devices, etc. These radiations can be associated with increased health problems of the users. This review aims to determine the effects of non-ionizing electromagnetic radiations on female fertility. To date, several in vitro and in vivo studies unveiled that

exposure to non-ionizing radiations brings about harmful effects on oocytes, ovarian follicles, endometrial tissue, estrous cycle, reproductive endocrine hormones, developing embryo, and fetal development in animal models. Non-ionizing radiation also upsurges the free radical load in the uterus and ovary, which leads to inhibition of cell growth and DNA disruptions. In conclusion, non-ionizing electromagnetic radiation can cause alterations in both germ cells as well as in their nourishing environment and also affect other female reproductive parameters that might lead to infertility.

Conclusion

According to the findings of this review, it can be concluded that non-ionizing EMRs radiated from cell phones, laptops, bluetooth devices, microwave ovens, or wireless networks might have detrimental effects on female fertility. Non-ionizing radiation can have destructive effects on ovary and uterus, affecting several reproduction parameters in females, such as folliculogenesis, oocyte morphology, and differentiation, hormones, reproductive cycle, and could lead to DNA damage. These effects may lead to subfertility and infertility due to increased free radical load and oxidative stress in the ovaries and uterus generated by these radiations. However, the effect of non-ionizing radiation on human gamete vis-à-vis female fertility is still poorly understood. Also, the findings of a whole-body EMR exposure in the same animal do not anticipate the results of a local EMR exposure. As a result, the outcomes of whole-body EMR exposure in animals cannot be directly compared to the outcomes of local EMR exposure in humans while using cell phones. Unfortunately, specific frequency and SAR value that causes impairment in the reproductive parameters and the exact mechanism of EMR action are not known so far. Moreover, further investigations are required to elucidate the role of EMR from mobile phones, Wi-Fi, and other devices in female fertility. Lastly, it is the need of the hour to understand the exact mechanism of EMR action on female fertility, establish safe exposure limits, and overcome the radiation effects.

https://pubmed.ncbi.nlm.nih.gov/35132884/

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Nargess Moghadasi, Iraj Alimohammadi, Ali Safari Variani, Azadeh Ashtarinezhad. The Effect of Mobile Radiation on the Oxidative Stress Biomarkers in Pregnant Mice. J Family Reprod Health. 2021 Sep;15(3):172-178. doi: 10.18502/jfrh.v15i3.7134.

Abstract

Objective: Due to the growing use of communication instruments such as cell phones and wireless devices, there is growing public concern about possible harmful effects, especially in sensitive groups such as pregnant women. This study aimed to investigate the oxidative stress induced by exposure to 900 MHz mobile phone radiation and the effect of vitamin C intake on reducing possible changes in pregnant mice.

Materials and methods: Twenty-one pregnant mice were divided into three groups (control, mobile radiation-exposed, and mobile radiation plus with vitamin C intake co-exposed (200 mg /kg)). The mice in exposure groups were exposed to 900 MHz, 2 watts, and a power density of 0.045 µw /cm2 mobile radiation for eight hours/day for ten consecutive days. After five days of rest, MDA (Malondialdehyde), 8-OHdG (8-hydroxy-2' -deoxyguanosine), and TAC (Total Antioxidant Capacity) levels were measured in the blood of animals. The results were analyzed by SPSS.22.0 software.

Results: The results showed that exposure to mobile radiation increased MDA (P=0.002), and 8-OHdG (P=0.001) significantly and decreased Total Antioxidant Capacity in the exposed groups (P=0.001). Taking vitamin C inhibited the significant increase in MDA and 8-OHdG levels in exposed groups.

Conclusion: Although exposure to mobile radiation can cause oxidative stress in the blood of pregnant mice, vitamin C as an antioxidant can prevent it.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8536820/

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Fatehi D, Anjomshoa M, Mohammadi M, Seify M, Rostamzadeh A. Biological effects of cell-phone radiofrequency waves exposure on fertilization in mice; an in vivo and in vitro study. Middle East Fertility Society Journal, 23(2):148-153. June 2018.

Abstract

Increasing use of cell-phone is one of the most important risk factors for population health. We designed an experimental study aimed at evaluating the effects of cell-phone radiofrequency (RF) waves exposure on fertilization in mice. Two hundred male and female NMRI-mice were used. One hundred males divided in five groups (n = 20) as control and exposed groups. Those irradiated with cell-phone RF in “Standby-mode” 1, 5 and 10 h daily named groups II, III and IV; respectively. Group V irradiated with cell-phone on “Active-mode” one hour daily. After 30 days irradiation, 50 males and 50 females were kept 24 h to assess their embryos. Fifty males were scarified to evaluate both in vitro and in vivo parameters, and 50 females received PMSG & HCG for both quantitative and qualitative evaluation. Comparing groups III, IV and V with control-group showed significantly decreased in the number of two-cell embryos (p = .000); however, a significant increase was found in the number of dead embryos (p = .000). Furthermore, 5 h daily irradiation significantly decreased grade-A embryos (p = .015); while, it significantly increased grade-B, C and D embryos (p-values = 0.026, 0.007, 0.006; respectively). Moreover, comparing groups IV and V to control-group, significant increase was found in pregnancy duration (p = .005, p = .009; respectively). However, in the mentioned groups a significant decrease was seen in number of newborn mice (p = .001, p = .004; respectively). In conclusion our findings showed that the cell-phone radiation can affect development of embryos as well as the number of newborn and pregnancy duration in NMRI-mouse, which might be a significant cause of reproductive failure.

Open access paper: https://www.sciencedirect.com/science/article/pii/S1110569017301875

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Shasin S, Singh SP, Chaturvedi CM. Mobile Phone (1800MHz) Radiation Impairs Female Reproduction in Mice, Mus musculus, through Stress Induced Inhibition of Ovarian and Uterine Activity. Reprod Toxicol. 2017 Aug 2.

Highlights

• Mice exposed to mobile phone radiation (MPR) in different operative modes.
• Ovarian & uterine histopathology, steroidogenesis & stress parameters were checked.
• Degenerative changes & reduced follicle count were observed in MPR exposed ovary.
• MPR resulted significant decrease in ovarian steroidogenic proteins & sex steroids.
• MPR induced oxidative & nitrosative stress impairs reproductive functions in mice.

Abstract

Present study investigated the long-term effects of mobile phone (1800MHz) radiation in stand-by, dialing and receiving modes on the female reproductive function (ovarian and uterine histo-architecture, and steroidogenesis) and stress responses (oxidative and nitrosative stress). We observed that mobile phone radiation induces significant elevation in ROS, NO, lipid peroxidation, total carbonyl content and serum corticosterone coupled with significant decrease in antioxidant enzymes in hypothalamus, ovary and uterus of mice. Compared to control group, exposed mice exhibited reduced number of developing and mature follicles as well as corpus lutea. Significantly decreased serum levels of pituitary gonadotrophins (LH, FSH), sex steroids (E2 and P4) and expression of SF-1, StAR, P-450scc, 3β-HSD, 17β-HSD, cytochrome P-450 aromatase, ER-α and ER-β were observed in all the exposed groups of mice,

compared to control. These findings suggest that mobile phone radiation induces oxidative and nitrosative stress, which affects the reproductive performance of female mice.

https://www.ncbi.nlm.nih.gov/pubmed/28780396

Excerpts

Experimental group mice were exposed to non-thermal (for body as a whole) mobile phone radiation (1800 MHz) by using Nokia 100 (2G, GSM) dual-band mobile phones continuously for four months (3 h/day for 120 days) in different operative modes i.e., dialing (dialing was performed), receiving (dialing signals from D-group was received) and stand-by (mobile phone was kept in just switched on mode) modes. From D-group mobile phones, only dialing signals (and not speech signals) were sent to the mobile phones of R-group. Dialing signals on the mobile phones of R-group were received so that both D- and R-group animals were in continuous condition of connectivity for 1½ hrs, then after a very small break (~10–15 s) again the dialing was initiated from the mobile phones of D-group and signals were received at the mobile phones of R-group and the continuity between the signal transmission and reception is maintained for another 1½ hrs. SB-group mice were kept beneath the **"switched-on"** mobile phones continuously for 3 h. Before the start of exposure, silent profile with no vibration was set for the mobile phones of all groups. To neutralize the box related and other external constraints, one sham control group was taken into account in each study. The control group mice were subjected to sham exposure in the same mobile phone exposure set-up for same time each day but with the mobile phones in **"switched-off"** condition.

This study demonstrate the deleterious effects of long-term 1800 MHz mobile phone radiation exposure in different operative modes i.e. dialing (D), receiving (R) and stand-by (SB) modes on female reproduction. Present experimental findings clearly elucidate that mobile phone radiation has a negative impact on female reproductive system. Outcome of the study demonstrates that long-term mobile phone irradiation causes alteration in ovarian and uterine morphology, histoarchitecture and activity. Mobile phone irradiated mice ovary revealed less number of developing and mature follicles with few corpus lutea and increased number of atretic/degenerative follicles. Although marked changes were observed in all the three experimental groups, the effects were more pronounced and severe in cases of R- and SB-groups of mice.

Overall, our study clearly elucidates that the long-term 1800 MHz mobile phone exposure impairs female reproductive system possibly via inducing both oxidative and nitrosative stress. Our study also suggests that mobile phone exposure produces deleterious effect on hypothalamus, ovary and uterus, and thus affects the ovarian and uterine activity and histoarchitecture adversely. Mobile phone radiation may result in ovarian and uterine dysfunction by increasing ROS and RNS production and disturbing antioxidant status. Oxidative and nitrosative stress created at the hypothalamus and peripheral level (ovary and uterus) as a consequence of long-term mobile phone exposure may severely reduce both steroidogenesis and folliculogenesis in the ovary as well as the structural and functional status of the uterus.

These results led us to conclude that chronic exposure to long-term mobile phone radiation may severely affect the ovarian and uterine activity of female mice and thus may lead to infertility. The effects were more pronounced/deleterious in stand-by and receiving conditions. Further, the results of this study performed on the rodent model, *Mus musculus*, may not be extrapolated to human being as the SAR value delivered to human at the ovary or uterus end will be much less than (and not comparable to) the value for the rodent at the desired site due to greater depth of the site from the skin surface of human being, assuming large body size ratio between two type of subjects, i.e., human being and rodent. However, if the human being is exposed to mobile phone radiation over longer duration, there may be the possibility of the radiation producing similar effect on human female reproductive system, on the assumption, that the total energy absorbed in the two cases is of same order of magnitude. Therefore, we anticipate that, these findings will improve our understanding of the etiology of female infertility due to heavy mobile phone usage.

The rise in female infertility problems may be, at least in part, due to a contribution from mobile phone radiation exposure to females. Hence, we anticipate that the outcome of the present study will not only contribute in framing of proper guidelines for safer use of mobile phone, which is an unavoidable device of present life style but may also assist in deciding the threshold limits to minimize adverse effects of the long term exposure to mobile phone radiations for females. However, further investigation is required in humans and non-human primates to determine whether the risks are similar and to establish safe exposure limits.

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Chen H, Qu Z, Liu W. Effects of Simulated Mobile Phone Electromagnetic Radiation on Fertilization and Embryo Development. Fetal Pediatr Pathol. 2016 Dec 16:1-7.

Abstract

This study investigated the effects of 935-MHz electromagnetic radiation (ER) on fertilization and subsequent embryonic development in mice. Ovulating mice were irradiated at three ER intensities for 4 h/day (d) or 2 h/d for three consecutive days; the ova were then harvested for in vitro fertilization to observe the 6-h fertilization rate (6-FR), 72-h morula rate (72-MR), and 110-h blastula rate (110-BR). Compared with the control group, the 6-FR, 72-MR, and 110-BR were decreased in the low ER intensity group, but the differences were not significant; in the mid- and high-intensity ER groups, 72-MR and 110-BR in the 4 h/d and 2 h/d subgroups were decreased, showing significant differences compared with the control group. Moreover, the comparison between 4 h/d and 2 h/d subgroups showed significant differences. Mid- and high-intensity ER at 935 MHz can reduce the fertilization rate in mice, and reduce the blastulation rate, thus reducing the possibility of embryo implantation.

https://www.ncbi.nlm.nih.gov/pubmed/27983879

Excerpts

Electromagnetic radiation devices consisted of four parts: a signal source (with frequency ranging from 935 to 960 MHz and magnetic field strength ranging from –15 db to +15 db), a rectifier (220 VAC/27 VDC; 300 W), a power amplifier, and a specific antenna with a length of 15 cm.

The mice were divided into seven groups by using a random table method: low-intensity (2 h/d and 4 h/d subgroups), mid-intensity (570 $\mu W/cm^2$: 2 h/d and 4 h/d subgroups), high-intensity (1400 $\mu W/cm^2$: 2 h/d and 4 h/d subgroups), and control groups.

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Stress May Diminish a Woman's Fertility, Study Suggests

First U.S. review to show a possible link between stress and how long it takes to get pregnant

Mary Brophy Marcus, HealthDay News, Mar 24, 2014

Stress may increase a woman's risk of infertility, new research suggests.

The authors of the study wanted to investigate the relationship between stress and infertility. So they looked at levels of an enzyme linked with stress in the saliva of women who were trying to get pregnant.

They also tracked the women's ability to conceive over a 12-month period.

"Women with higher levels of the stress biomarker had a two-fold increased risk of infertility," said study author Courtney Lynch. The enzyme they measured is called salivary alpha-amylase.

"Alpha-amylase is an enzyme that is secreted into the mouth that helps the body start to digest carbohydrates," said Lynch, director of reproductive epidemiology at the Ohio State University College of Medicine. "It is also linked to the fight-or-flight part of the stress system."

For the study, Lynch and her colleagues collected data from about 500 couples who were recruited from targeted counties in Texas and Michigan.

"We tried to find couples who were just starting to try to get pregnant," Lynch said. "We sent a nursing team out to their houses who did interviews and trained the women how to use saliva-collection kits."

The women took saliva samples twice -- at the start of the study and again after they'd had their first menstrual period during the study time frame. For most, that was about a month into the study, Lynch said. Since alpha-amylase can be affected by alcohol, tobacco and caffeine consumption, the researchers asked the women to take their saliva samples right after waking up in the morning.

The researchers followed the couples for up to 12 months, collecting information on whether they'd conceived.

Of the approximately 400 couples who completed the study, 87 percent of the women became pregnant. After adjusting for age, race, income and the use of alcohol, caffeine and cigarettes, the researchers found that the women with the highest alpha-amylase levels had a 29 percent lower probability of pregnancy compared to the women who had the lowest levels of the enzyme.

The study results were published in the March 24 issue of the journal *Human Reproduction*.
Lynch said it's important to be clear that the results do not suggest that stress alone is the reason a woman can't get pregnant.

"The message is not that everyone should go enroll in yoga tomorrow," she said. "The message is that if you've tried for five or six months and you aren't getting anywhere, maybe you should look at your lifestyle and think about whether or not stress might be a problem for you.

And if it is, you might want to consider a stress-management program."

The authors said this is the first U.S. study to show a possible association between a stress indicator and how long it takes a woman to become pregnant.

Dr. Suleena Kansal Kalra is a reproductive endocrinology and infertility specialist at the University of Pennsylvania. She called the new research "a great first step -- it's presenting a way to measure [indicators] of stress."

"Part of the challenge is that we don't have validated [indicators] of stress hormones or validated questionnaires that measure stress, so the next step is that we really need to start validating some of these tools," said Kalra, who was not involved with the new research.

"Ultimately, we want to know how we can measure stress, and then, can we intervene?"

Exactly how stress affects fertility is not well understood, Lynch said. The study's authors said the women in the group with higher levels of the stress-related enzyme had sex about as often as those in the low-level group, so frequency of intercourse did not play a role.

Kalra said some women stop ovulating during stressful times, while others conceive in high-stress environments.

Lynch said the researchers have also collected data on men but have not yet analyzed it, so it's not yet clear how much a man's stress might influence a couple's fertility.

Women struggling with infertility who have stressful lifestyles should not blame themselves, Lynch said. "I don't want women to see this in the news and say, 'It's my fault I'm not pregnant,'" she said. "We know stress is not the major indicator of whether or not you're going to get pregnant."

Kalra agreed, noting that, "Age is the No. 1 factor linked to the inability to conceive. Mother Nature is cruel and unfair. All our success rates are better in women under 35. That does not mean every woman in her late 30s is going to be infertile, but age is the greatest predictor of success."

She added that cigarette smoking is "absolutely associated with a decrease in the ability to become pregnant," and obesity is beginning to be looked at as well.

Kalra is launching a fertility wellness program this spring at Penn that will combine yoga, meditation, nutrition counseling and a psychologist-led support group to help women who are hoping to become pregnant.

"Not being able to start your family when you're ready to do so can create a lot of stress for couples, particularly women," Kalra said.

"I'm not sure stress is an underlying cause of infertility, and I often find it counterproductive to tell women if they're a little less stressed they would become pregnant," she said. "We don't know if that's true. I generally say, 'I want you to feel as good as possible when you're embarking on the journey to have a family.' "

More information

To learn more about reducing stress, visit the U.S. National Center for Complementary and Alternative Medicine.

SOURCES: Courtney Lynch, Ph.D., M.P.H., director, reproductive epidemiology, and assistant professor, obstetrics and gynecology and epidemiology, Ohio State University College of Medicine; Suleena Kansal Kalra, M.D., M.S.C.E., assistant professor, obstetrics and gynecology, and director, fertility wellness program, University of Pennsylvania, Philadelphia; March 24, 2014, *Human Reproduction*, online

http://bit.ly/1jJnHVI

Lynch CD, Sundaram R, Maisog JM, Sweeney AM, Buck Louis GM.Preconception stress increases the risk of infertility: results from a couple-based prospective cohort study--the LIFE study. Hum Reprod. 2014 Mar 23.

Abstract

STUDY QUESTION: Are women's stress levels prospectively associated with fecundity and infertility?

SUMMARY ANSWER: Higher levels of stress as measured by salivary alpha-amylase are associated with a longer time-to-pregnancy (TTP) and an increased risk of infertility.

WHAT IS KNOWN ALREADY: Data suggest that stress and reproduction are interrelated; however, the directionality of that association is unclear.

STUDY DESIGN, SIZE, DURATION: In 2005-2009, we enrolled 501 couples in a prospective cohort study with preconception enrollment at two research sites (Michigan and Texas, USA). Couples were followed for up to 12 months as they tried to conceive and through pregnancy if it occurred. A total of 401 (80%) couples completed the study protocol and 373 (93%) had complete data available for this analysis.

PARTICIPANTS/MATERIALS, SETTING, METHODS: Enrolled women collected saliva the morning following enrollment and then the morning following their first observed study menses for the measurement of cortisol and alpha-amylase, which are biomarkers of stress. TTP was measured in cycles. Covariate data were captured on both a baseline questionnaire and daily journals.

MAIN RESULTS AND THE ROLE OF CHANCE: Among the 401 (80%) women who completed the protocol, 347 (87%) became pregnant and 54 (13%) did not. After adjustment for female age, race, income, and use of alcohol, caffeine and cigarettes while trying to conceive, women in the highest tertile of alpha-amylase exhibited a 29% reduction in fecundity (longer TTP) compared with women in the lowest tertile [fecundability odds ratios (FORs) = 0.71; 95% confidence interval (CI) = (0.51, 1.00); P < 0.05]. This reduction in fecundity translated into a >2-fold increased risk of infertility among these women [relative risk (RR) = 2.07; 95% CI = (1.04, 4.11)]. In contrast, we found no association between salivary cortisol and fecundability.

LIMITATIONS, REASONS FOR CAUTION: Due to fiscal and logistical concerns, we were unable to collect repeated saliva samples and perceived stress questionnaire data throughout the duration of follow-up. Therefore, we were unable to examine whether stress levels increased as women continued to fail to get pregnant. Our ability to control for potential confounders using time-varying data from the daily journals, however, minimizes residual confounding.

WIDER IMPLICATIONS OF THE FINDINGS: This is the first US study to demonstrate a prospective association between salivary stress biomarkers and TTP, and the first in the world to observe an association with infertility.

STUDY FUNDING/COMPETING INTEREST(S): This study was supported by the Intramural Research Program of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (contracts #N01-HD-3-3355, N01-HD-3-3356, N01-HD-3358). There are no conflicts of interest to declare.

http://www.ncbi.nlm.nih.gov/pubmed/24664130

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Augner C, Hacker GW. Are people living next to mobile phone base stations more strained? Relationship of health concerns, self-estimated distance to base station, and psychological parameters. Indian J Occup Environ Med. 2009 Dec;13(3):141-5.

Abstract

BACKGROUND AND AIMS: Coeval with the expansion of mobile phone technology and the associated obvious presence of mobile phone base stations, some people living close to these masts reported symptoms they attributed to electromagnetic fields (EMF). Public and scientific discussions arose with regard to whether these symptoms were due to EMF or were nocebo effects. The aim of this study was to find out if people who believe that they live close to base stations show psychological or psychobiological differences that would indicate more strain or stress. Furthermore, we wanted to detect the relevant connections linking self-estimated distance between home and the next mobile phone base station (DBS), daily use of mobile phone (MPU), EMF-health concerns, electromagnetic hypersensitivity, and psychological strain parameters.

DESIGN, MATERIALS AND METHODS: Fifty-seven participants completed standardized and non-standardized questionnaires that focused on the relevant parameters. In addition, saliva samples were used as an indication to determine the psychobiological strain by concentration of alpha-amylase, cortisol, immunoglobulin A (IgA), and substance P.

RESULTS: Self-declared base station neighbors (DBS </= 100 meters) had significantly higher concentrations of alpha-amylase in their saliva, higher rates in symptom checklist subscales (SCL) somatization, obsessive-compulsive, anxiety, phobic anxiety, and global strain index PST (Positive

Symptom Total). There were no differences in EMF-related health concern scales.

CONCLUSIONS: We conclude that self-declared base station neighbors are more strained than others. EMF-related health concerns cannot explain these findings. Further research should identify if actual EMF exposure or other factors are responsible for these results.

http://www.ncbi.nlm.nih.gov/pubmed/20442833

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Augner C, Hacker GW, Oberfeld G, Florian M, Hitzl W, Hutter J, Pauser G. Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A. Biomed Environ Sci. 2010 Jun;23(3):199-207.

Abstract

OBJECTIVE: The present study aimed to test whether exposure to radiofrequency electromagnetic fields (RF-EMF) emitted by mobile phone base stations may have effects on salivary alpha-amylase, immunoglobulin A (IgA), and cortisol levels.

METHODS: Fifty seven participants were randomly allocated to one of three different experimental scenarios (22 participants to scenario 1, 26 to scenario 2, and 9 to scenario 3). Each participant went through five 50-minute exposure sessions. The main RF-EMF source was a GSM-900-MHz antenna located at the outer wall of the building. In scenarios 1 and 2, the first, third, and fifth sessions were "low" (median power flux density 5.2 microW/m(2)) exposure. The second session was "high" (2126.8 microW/m(2)), and the fourth session was "medium" (153.6 microW/m(2)) in scenario 1, and vice versa in scenario 2. Scenario 3 had four "low" exposure conditions, followed by a "high" exposure condition. Biomedical parameters were collected by saliva samples three times a session. Exposure levels were created by shielding curtains.

RESULTS: In scenario 3 from session 4 to session 5 (from "low" to "high" exposure), an increase of cortisol was detected, while in scenarios 1 and 2, a higher concentration of alpha-amylase related to the baseline was identified as compared to that in scenario 3. IgA concentration was not significantly related to the exposure.

CONCLUSIONS: RF-EMF in considerably lower field densities than ICNIRP-guidelines may influence certain psychobiological stress markers.

http://www.ncbi.nlm.nih.gov/pubmed/20708499

Nazıroğlu M, Yüksel M, Köse SA, Özkaya MO. Recent reports of Wi-Fi and mobile phone-induced radiation on oxidative stress and reproductive signaling pathways in females and males.J Membr Biol. 2013 Dec;246(12):869-75.

Abstract

Environmental exposure to electromagnetic radiation (EMR) has been increasing with the increasing demand for communication devices. The aim of the study was to discuss the mechanisms and risk factors of EMR changes on reproductive functions and membrane oxidative biology in females and males. It was reported that even chronic exposure to EMR did not increase the risk of reproductive functions such as increased levels of neoantigens abort. However, the results of some studies indicate that EMR induced endometriosis and inflammation and decreased the number of follicles in the ovarium or uterus of rats. In studies with male rats, exposure caused degeneration in the seminiferous tubules, reduction in the number of Leydig cells and testosterone production as well as increases in luteinizing hormone levels and

apoptotic cells. In some cases of male and female infertility, increased levels of oxidative stress and lipid peroxidation and decreased values of antioxidants such as melatonin, vitamin E and glutathione peroxidase were reported in animals exposed to EMR. In conclusion, the results of current studies indicate that oxidative stress from exposure to Wi-Fi and mobile phone-induced EMR is a significant mechanism affecting female and male reproductive systems. However, there is no evidence to this date to support an increased risk of female and male infertility related to EMR exposure.
Conclusions

.. EMR exposure from Wi-Fi and mobile phones is related to oxidative stress and overproduction of free oxygen radicals in female and male infertility. Use of mobile phones and wireless devices has been increasing day by day. There are very scarce data on Wi-Fi-induced reproductive dysfunction in female and male individuals. However, carcinogenic and proliferative effects of mobile phones (Kim et al. 2010) and Wi-Fi (Kumar et al. 2011; Kesari et al. 2011; Nazırog˘lu et al. 2012b) have been reported in animals and cell culture systems, although there is no report on Wi-Fi- or mobile phone-induced cancer in reproductive tissues of female and male individuals. In the future, the role of EMR from mobile phones and wireless devices in female and male fertility should be investigated.

http://www.ncbi.nlm.nih.gov/pubmed/24105626

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Shibkova DZ, Shilkova TV, Ovchinnikova AV. [Early and Delayed Effects of Radio Frequency Electromagnetic Fields on the Reproductive Function and Functional Status of the Offspring of Experimental Animals]. [Article in Russian]. Radiats Biol Radioecol. 2015 Sep-Oct;55(5):514-9.

Abstract

The aim of our experimental research was to study the impact of radio frequency electromagnetic fields (RF EMF) on the reproductive function of male and female mice of CBA in 2 models of exposure, as well as on the morphofunctional state of progeny of irradiated animals. It was found that RF EMF under conditions of repeated short-term exposures (within 5 days for 10 minutes at PES 1.2 mW/cm2) affects the course of pregnancy in female mice, the number of litters, fertility and preservation of offspring, morphometric characteristics of the offspring of experimental animals at different models of irradiation (exposure of animals to RF EMF prior to mating and during pregnancy).

http://www.ncbi.nlm.nih.gov/pubmed/26863782