*Available online at*www.pelagiaresearchlibrary.com

Pelagia Research Library

European Journal of Experimental Biology, 2016, 6(4):46-51

ISSN: 2248 –9215
CODEN (USA): EJEBAU

A Survey on the Impact of Radiofrequency Electromagnetic Fields (RF-EMF) from Wireless Devices on Information Technology (IT) Professionals

Sivani Saravanamuttu* and Sudarsanam Dorairaj

Department of Advanced Zoology and Biotechnology, Loyola College, Chennai, Tamil Nadu, India

---

ABSTRACT

An enormous growth in the telecommunication industry has led to an increase in the usage of a number of wireless devices. The impact of working in an environment saturated with wireless radiation needs to be explored. A questionnaire was prepared based on 18 non-specific health symptoms and medical conditions. It was circulated among professionals (n=200) in the Information Technology (IT) companies and the data was statistically analyzed. Both male and female IT professionals possessed cell phones (100%), 19.66% used cordless phones and 2.25% of them used the landline telephones. When compared to the males, it was found that 80.4% of the females used wireless computer networks (p>0.01), 27.2% used the microwave ovens (p>0.01) and 47.8% used Bluetooth devices (p>0.001). Significant non-specific symptoms (p>0.001) seen in females were headaches, tremors, depression, blurred vision, irritability, difficulty concentrating, chronic pain, pain in teeth and deteriorated fillings, and dryness of lips, tongue, mouth and eyes. The males had poor short-term memory, difficulty sleeping and fatigue. Significant medical conditions noted in the females were allergies and asthma at 18.5% (p>0.001) and skin problems at 26.1% (p>0.01), and in the males were eye-related problems at 21.1% (p>0.01). Non-thermal effects of wireless radiation need to be investigated globally in the coming years.

Key words: Radiofrequency; electromagnetic fields; frequency; wireless; electrohypersensitive

---

INTRODUCTION

There has been unprecedented growth in the global communication industry in recent years which has resulted in a dramatic increase in the number of wireless devices like cell phones and cell phone towers, which form the supporting infrastructure. Apart from the increase in use of wireless devices worldwide both in number of users and duration of use, there has been a tremendous technological advancement with the introduction of third (3G) and fourth (4G) generation wireless devices with the fifth (5G) generation in the offing [1,2,3].The cell phone towers provide the link to and from the cell phones. Better cellular network connection and lower energy output from the cell phones are ensured by a dense network of cell phone towers. Hence, the general population will receive the highest RF-EMF exposures from cell phone towers in such areas. The cell phone towers in an urban city are placed on buildings as well as on the ground. In an occupational setting, the Wi-Fi routers are placed inside the buildings. Hence, people are being exposed involuntarily to continuous, non-thermal, non-ionizing radiations from these cell phone towers and routers, which are increasing every year [4]. There have been no detailed research analysis by the scientific community about the possible health consequences, although these new technologies have been highly commercialized, and people in general, children and adolescents in particular, are bombarded with advertisements, enticing them with the latest, powerful wireless devices, which are no longer a luxury but have been made a necessity.

This research was undertaken to record the health effects of people in an environment of voluntary and involuntary

whole-body RF-EMF radiation exposure, professionals in the Information Technology (IT) field, living and working in an environment saturated with RF-EMF radiation.

MATERIALS AND METHODS

A questionnaire was prepared based on 18 non-specific health symptoms and medical conditions. It was circulated among professionals (*n=200*) in the Information Technology (IT) companies in Tidel Park in the IT Corridor, Tharamani, in South Chennai, an area which was high in outdoor RF-EMF radiation. General questions included gender, marital status, age and diet. Alcoholics and smokers were eliminated from this sample group (*n=178*). Exposure conditions were determined by the hours at work and sleep, hours per day and years of use of cell phones, cordless phones, wired and wireless computer. The questionnaire sought information on non-specific health symptoms and medical conditions. The frequency of symptoms were expressed using a scale of 0=never, 1=rare, 2=sometimes and 3=often and severity in terms of low, medium and high. The data was statistically analysed with tools such as Chi-square test, t-test, discriminant analysis with F statistics and Duncan Multiple Range Test (DMRT), using software IBM SPSS, Version 17.

RESULTS

Among the Information Technology (IT) professionals surveyed, compared to males at 48.3%, females showed higher representation at 51.7%; compared to married people at 29.8%, unmarried were higher in representation at 70.2%; compared to vegetarians at 34.8%, non-vegetarians were higher in representation at 65.2%; people in the age group of below 25 years were higher in representation at 56.2% followed by between 25-30 years at 32.6% and above 30 at 11.2%. People who worked for 9 hours/day were higher in representation at 56.7%, followed by 10 hours/day at 23.6%, 11 hours/day at 12.4%, 8 hours/day at 4.5% and 12 hours/day at 2.8%. Those who slept for 6 hours/day were higher in representation at 36.5%, followed by 7 hours/day were 27.5%, 8 hours/day were 24.2% and 5 hours/day were 11.8%.

The frequency of symptoms often experienced included hair loss (32.02%), difficulty sleeping (12.36%), poor short-term memory and pain in teeth and deteriorated fillings (10.11%), headache (8.99%), fatigue and dryness of lips, tongue, mouth, eyes (5.06%) and depression (2.81%). As for severity, the symptoms often experienced were hair loss (22.47%), poor short-term memory (10.11%), pain in teeth and deteriorated fillings (10.11%), difficulty sleeping (7.30%), irritability (7.30%), difficulty concentrating (7.30%), headache (6.18%), fatigue (5.06%), and dryness of lips, tongue, mouth and eyes (5.06%). Both male and female IT professionals possessed cell phones (100%), 80.34% of them used a wired computer, 73.60% wireless computer, 20.22% microwave, 19.66% cordless phone and only 2.25% of them used the landline telephone.

As for the frequency of symptoms, there was a positive relationship between cell phone use and the following: irritability at 67% ($p<0.01$), hair loss at 58% ($p<0.01$),difficulty concentrating at 48% ($p<0.01$), difficulty sleeping at 46% ($p<0.01$), blurred vision at 41% ($p<0.05$), dryness of lips, tongue, mouth and eyes at 39% ($p<0.01$), pain in teeth at 34% ($p<0.01$), depression at 28% ($p<0.01$), headache at 24% ($p<0.01$), poor short-term memory at 27% ($p<0.01$), dizziness at 20% ($p<0.01$), fatigue at 17% ($p<0.05$), ringing in the ears at 18% ($p<0.05$), impaired sense of smell at 17% ($p<0.05$)and loss of libido at 15% ($p<0.05$).

As for the severity of symptoms, there was a positive relationship between cell phone use and the following: headache at 27% ($p<0.01$), poor short-term memory at 54% ($p<0.01$), dizziness at 25% ($p<0.01$), depression at 29% ($p<0.01$), blurred vision at 46% ($p<0.01$), difficulty sleeping at 56% ($p<0.01$), irritability at 18% ($p<0.05$), difficulty concentrating at 25% ($p<0.01$), fatigue at 17%, ringing in the ears at 18% ($p<0.05$), hair loss and cell phone use per year at 37% ($p<0.01$), impaired sense of smell at 17% ($p<0.05$), pain in teeth and deteriorated fillings at 34% ($p<0.01$), dryness of lips, tongue, mouth and eyes at 39% ($p<0.01$) and loss of libido at 17% ($p<0.05$).

When compared to the males, the females had the following non-specific symptoms: Frequent (69.6%) and severe (48.9%) headaches ($p>0.001$); frequent (21.7%) tremors ($p>0.001$), frequent (19.6%) and severe (19.6%) depression ($p>0.001$); frequent (19.6%) ($p>0.01$) and severe (19.6%) blurred vision ($p>0.001$); frequent (48.9%) and severe (48.9%) irritability ($p>0.001$); severe (30.4%) difficulty concentrating ($p>0.001$); frequent (19.6%) and severe (19.6%) chronic pain ($p>0.001$); frequent (39.1%) and severe (39.1%) pain in teeth and deteriorated fillings ($p>0.001$); frequent (26.1%) and severe (26.1%) dryness of lips, tongue, mouth and eyes ($p>0.001$).When compared to the females, the males had severe (41.9%) poor short-term memory ($p>0.001$), frequent (51.2%) and severe (36%) difficulty sleeping ($p>0.001$), frequent (41.9%) and severe (41.9%) fatigue ($p>0.01$) (Table 1).

When compared to the males, females had medical conditions such as allergies and asthma at 18.5% ($p>0.001$) and skin problems at 26.1% ($p>0.01$), whereas the males had more eye-related problems at 21.1% ($p>0.01$) (Table 2). Among the male and female IT professionals, only 4.7% of the males used the wired or landline phones and none of the females used it ($p>0.01$). More males (90.7%) used wired computer networks than the females (70.7%) ($p>0.001$). When compared to the males, it was found that 80.4% of the females used wireless computer networks ($p>0.01$), 27.2% used the microwave ovens ($p>0.01$) and 47.8% used a Bluetooth device ($p>0.001$) (Table 3).The mean level of usage of devices in females was higher than the males in the following aspects: cell phone use per year ($p>0.01$), wired computer network use per year ($p>0.001$), wireless computer network use per year and per hour ($p>0.001$). The mean level of males was higher than the females in the following aspects: cell phone use per hour ($p>0.001$) and cordless phone use per hour ($p>0.01$).

DISCUSSION

Over millions of years, living creatures have evolved on earth in water due to the electromagnetic energy, and currently human-made frequencies have increased in the environment; whether they pose a challenge to health and survival is disputed by many scientists in spite of the mounting evidence that they indeed do. Author, Katie Singer's [5] "An Electronic Silent Spring" is a pioneering book about the impacts of exposure to radiation from man-made electricity and wireless devices on birds, wildlife and human health, with solution to reduce and mitigate the harm caused by the exposure to electromagnetic radiation. The book, "Black on White [6]", published in 2002, is based on documents from the Council for Work Life Research on more than 400 electrohypersensitive people. According to them, computers were perceived as the most usual triggering factor for their electrohypersensitivity, followed by cellular phones/base stations and cordless phones among others. Skin problems top the list, followed by sensitivity to light, eye problems, problems with heart and blood pressure, headaches, migraines, pain in joints and muscles, dizziness, concentration difficulties, nausea, memory disorders and endocrine reactions. In this survey, IT professionals who work in an environment of constant wireless radiation were found to be highly susceptible to RF-EMF. Females used more wireless devices compared to males. Overall, more non-specific symptoms and medical issues were noted in females than males.

In the case of South Korea, 100% of the households have access to broadband infra-structure. The government estimates that up to 30% of those under 18 years of age are at risk.Many experiments have detected the deleterious effects of RF-EMF fields on cognitive functions such as short- and long-term memory, attention, reaction time, and concentration among people living near cell phone towers [7]. A meta-analysis by Hardell *et al*[8] has found an elevated risk of brain tumors, low-grade astrocytoma and acoustic neuroma in individuals who have regularly used the cell phones for ten years or longer. There was a higher risk of developing glioma in individuals who had started to use the cell phones in their 20s when compared to the older persons. The results of INTERPHONE study[9], conducted in 13 countries namely, Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden and UK, to assess the risks of tumors of the brain (glioma and meningioma), acoustic nerve (schwannoma) and parotid gland, in relation to mobile telephone use, revealed that there was no increase in risk of glioma or meningioma, but there were suggestions of an increased risk of glioma at the highest exposure levels. In a study by a team from Israel, which was a part of the INTERPHONE study, showed an elevated risk of parotid gland cancer among long-term users of cell phones[10]. Epidemiological evidence of an association between RF-EMF radiation and cancer comes from studies on populations exposed to RF radiation in occupational settings, from sources in the general environment and from use of wireless devices such as cell phones and cordless phones.

According to Fox [11], the nervous system of every species including humans can detect EMF, but it is not developed in most humans because it was not useful to them historically. While living next to a cell phone tower, due to constant RF-EMF exposure, the nervous system detects a change, which is interpreted as a threat, and the fight or flight response is switched on. Calming this response by avoiding exposure to such pollutants is very difficult to do in modern life. People who are in a constant state of nervous system arousal suffer the most. When such people get additional exposures, the nervous system goes from order into a chaos state, leading to chronic pain, anxiety, sleeplessness, short-term memory loss, lack of concentration and increased fear psychosis.

The criteria identified in 1999 by researchers for the diagnosis of multiple chemical sensitivity (MCS) can be applied to electrohypersensitivity (EHS), such as migraines, irritable bowel and bladder, fibromyalgia, chronic fatigue and chronic pain. They can be triggered by an acute or chronic RF-EMF exposure, with symptoms reproducible with repeated exposures, the condition persisting for a significant period of time, levels of exposure lower than commonly tolerated resulting in increased sensitivity, symptoms improving or resolving completely when the triggers are removed. These responses often occur due to multiple unrelated triggers and symptoms involve multiple organs. The patients have lower threshold of tolerance to various stressors and higher excitation within the nervous system. EHS can be limited by avoiding the environmental triggers. They also cause severe

depression [12]. Mobile phone use after lights out may be associated with poor mental health, suicidal feelings and self-injury in both early and late adolescents [13].

A case study in Sweden showed that 250,000 Swedes were allergic to mobile phone radiation and were termed as being electrohypersensitive. It was recognised as a physical degradation and EHS sufferers were entitled to have metal shielding installed in their homes free of charge from the local government [14,15]. In an epidemiological study from Netherlands, questionnaires and electronic medical records of the respondents were combined. The groups included non-sensitive individuals, the general environmental sensitivity group and idiopathic environmental intolerance attributed to electromagnetic fields group. On analysis, it was found that environmentally sensitive individuals experienced poorer health, increased illness behavior and more severe non-specific physical symptoms [16].

The potential effect of exposure to cellular phones has been studied extensively, but the results remain inconclusive. Recent genomic analyses, using the genome-wide association study (GWAS) design have identified several inherited risk variants that are associated with increased glioma risk [17]. In order to analyze the association between prevalence of fatigue referred by physical therapists and their occupational exposure to radiation emitted by therapeutic microwave diathermy equipment, a cross-sectional study was conducted in four cities of the west of Paraná State, Brazil. A web questionnaire and a Multidimensional Assessment of Fatigue (MAF) were undertaken. The results demonstrated a significant and independent association between occupational exposure of physical therapists to radiation of microwave diathermy and prevalence of fatigue. Therefore, occupational safety guidelines aimed at these professionals as a prevention of possible adverse effects, as well as the replication of this study are suggested [18].In the multicenter case-control study, CERENAT, carried out in four areas in France in 2004-2006, the association between mobile phone exposure and primary central nervous system tumors (gliomas and meningiomas) in adults was analyzed. It was found that the risks were higher for gliomas, temporal tumors, occupational and urban mobile phone use. Just as in previous studies, this study highlights a possible association between heavy mobile phone use and brain tumors [19].

According to Becker [20], who is a Nobel Prize nominee, at the present time, the greatest polluting element in the earth's environment is the proliferation of electromagnetic fields. The human body, according to Hyland [21], is "an electrochemical instrument of exquisite sensitivity" and like a radio it can be interfered with by incoming radiation. Therefore is it misguided to think that electromagnetic radiation would not be having a negative effect on public health.The Russian studies of 1960s clearly laid out how the process EHS developed over time. It begins with a period of stimulation and heightened awareness, followed by a period of adaptation and eventually followed by a period of organism decline. However if EMFs are removed during the stages of stimulation and adaptation, the organism can potentially recover from many of the disabilities experienced throughout the exposures. Reintroduction of EMFs can often lead to more severe disabilities and illness. Based on many of those early studies, most East European countries, Russia and China adopted RF emission standards 1000 to 10,000 times lower than the West. The Eastern Countries believed lower emission thresholds were justified in order to protect the population from the biological effects that was evident in the Eastern research at the time. Meanwhile the West justified their higher RF safety thresholds simply using a safety factor from the physical heating health effects of RF/microwave emission. According to Western science, physical heating was the only definitive health risk from RF/microwave emission observed in the research up to that time.Research on mitigation stated that the use of hands-free kits lowered exposure of the brain to less than 10% of the exposure from use at the ear, but it might increase exposure to other parts of the body [22].

Table 1: Frequency and Severity of non-specific symptoms seen in IT professionals

Non-specific symptoms	Males		Females	
	Frequency %	Severity %	Frequency %	Severity %
Headaches			69.6**	48.9**
Tremors			21.7**	
Depression			19.6**	19.6**
Blurred vision			19.6	19.6
Irritability			48.9	48.9
Difficulty concentrating				30.4
Chronic pain			19.6	19.6
Pain in teeth and deteriorated fillings			39.1	39.1
Dryness of lips, tongue, mouth and eyes			26.1	26.1
Poor short-term memory		41.9		
Difficulty sleeping	51.2	36		
Fatigue	41.9	41.9		

*** denotesp<0.01*

Table 2: Medical conditions seen in IT professionals

Medical conditions	Males %	Females %
Allergies and asthma		18.5**
Skin problems		26.1**
Eye problems	21.1**	

** *denotesp<0.01*

Table 3: Devices used by IT professionals

Devices	Males %	Females %
Wired or landline phone	4.7**	
Wired computer	90.7**	70.7**
Wireless computer		80.4**
Microwave oven		27.2**
Bluetooth device		47.8**

** *denotesp<0.01*

CONCLUSION

There is continuing scientific debate and increasing public concern regarding the possible effects of electromagnetic fields (EMF) on the health of the general population. Cell phone manuals do accept that cell phones are neither absolutely safe nor unsafe. The advice ranges from using hands-free, keeping device away from abdomen of pregnant women and lower abdomen of teenagers, limiting call time and not allowing it to come too close to human body and to consult a physician in case of eye or muscle twitching, loss of awareness, involuntary movement or disorientation. In order to reduce the risk of headaches, blackouts, seizures, and eyestrain, to avoid prolonged use, hold the wireless device at a distance from the eyes, to use in a well-lit room and to take frequent breaks. Continued research in this field and mitigation is required in the coming years.

Acknowledgements
The authors are thankful to Dr. G. Kumar, Antenna Lab, IIT-Bombay, for his valuable guidance and suggestions and to the Research Wing of Loyola College, Chennai 600 034, Tamil Nadu, India.

REREFENCES

[1] N. Savage, *Telecom Wireless, IEEE Spectrum*, **2014**. [Online] Available: http://spectrum.ieee.org/tech-talk/telecom/wireless/darpa-builds-first-terahertz-amplifier.
[2] A. Bleicher, *TelecomWireless, IEEE Spectrum*, **2014**.[Online] Available: http://spectrum.ieee.org/tech-talk/telecom/wireless/5g-service-on-your-4g-phone.
[3] T.S. Rappaport, W. Roh, K. Cheun, *TelecomWireless, IEEE Spectrum*, **2014**. [Online] Available: http://spectrum.ieee.org/telecom/wireless/smart-antennas-could-open-up-new-spectrum-for-5g
[4] S. Banerji, R.S. Chowdhury, *Indian J Eng*, **2013**, 2, 5.
[5] K. Singer, *An Electronic Silent Spring: Facing the Dangers and Creating Safe Limits*, Lindisfarne Books, **2014**, pp 1-310.
[6] R. Granlund-Lind, J. Lind, *Black on White,***2002**, [Online] Available: www.feb.se/feb/blackonwhite-complete-book.pdf.
[7] Stewart Report,*Mobile phones and health*, **2000**. [Online] Available: http://www.iegmp.org.uk/report/text.htm.
[8] L. Hardell, M. Carlberg, F. Söderqvist, K.H. Mild, L.L. Morgan, *Occup. Environ. Med*, **2007**,64,9, 626-632.
[9] INTERPHONE study, WHO-IARC, **2012**.[Online] Available: http://interphone.iarc.fr/interphone_results.php.
[10] S. Sadetzki, A. Chetrit, J. Jarus-Hakak, E. Cardis, Y. Deutch, *Am. J Epidemiol*, **2008**, 167, 457-467.
[11] E. Fox, Proceedings of the International Workshop on Electromagnetic Hypersensitivity, Prague, Czech Republic, World Health Organization (WHO),**2004**. [Online] Available: http://www.cellphonetaskforce.org/wp-content/uploads/2014/07/Brief-of-Amici-Curiae.pdf.
[12] D. Belpomme, Presentation at 8th National Congress on Electrosmog, **2011**, Berne. [Online] Available: http://citizensforsafetechnology.org/uploads/scribd/Presentation%20of%20Prof.pdf.
[13] N. Oshima, A. Nishida,S. Shimodera, M. Tochigi, S. Ando, *J Pediatr. Psychol*, **2012**,9, 1023-1030.
[14] G. Kumar, Report on Cell Tower Radiation, submitted to the Secretary, DoT, **2010**, Delhi, India. [Online] Available: http://www.ee.iitb.ac.in/~mwave/GK-cell-tower-rad-report-DOT-Dec2010.pdf.
[15] A. Fragopoulou, Y. Grigoriev, O. Johansson, L.H. Margaritis, *Rev. Environ. Health*.**2010**, 25, 4, 307-317.
[16] C. Baliatsas, I. van Kamp, M. Hooiveld, J. Yzermans, E. Lebret,*J Psychosom. Res*.,**2014**,76, 5, 405-413.
[17] Q.T. Ostrom, H. Gittleman, L. Stetson, S.M. Virk, J.S. Barnholtz-Sloan, *Cancer Treat. Res*, **2015**,163, 1-14.
[18] M.D. Anguera, R.J. Gianini, *Rev. Bras. Epidemiol*, **2014**,17,3, 577-581.
[19] G. Coureau, G. Bouvier, P. Lebailly, P. Fabbro-Peray, A. Gruber,*Occup. Environ. Med*, **2014**,71, 7, 514-522.

[20] R.O. Becker, G. Selden, *The Body Electric*. HarperCollins, USA, **2013**, pp 1-368.
[21] G.J. Hyland,*Lancet*,**2000**, 356,1833-1836.
[22] World Health Organization-International Agency for Research on Cancer. Non-ionizing radiation, Part II: Radiofrequency electromagnetic fields/IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Lyon, France, **2013**,102, 40.