

Environmental pollution due to mobile phone radiation, high voltage powerline radiation and investigating it's effects on heart rate and blood pressure

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ABSTRACT

Pollution due to Electromagnetic Radiation (EMR) is inevitable in today's world and it had affected our lives. Currently we are totally dependant upon the technologies which are the major sources of EMR. In many situations these radiation are more powerful than natural sources of radiation. A study was conducted in Pune city (India) to find out the effect of EMR emitted by Global System for Mobile (GSM) and high voltage powerline (HVPL) on health parameters like blood pressure and heart rate, for 20 healthy volunteers (10 male and 10 female), within age group 18-25 years. In the study, heart rate (HR) and blood pressure along with other health parameters are measured using multiparamonitor (Caddo 19B, Multipara set-up). The transmitter and receiver handset (Moto G 3rd Gen-XT 1550), GSM SIM (AIRCEL), distance between caller and receiver, time of observations and other external parameters are kept fixed. These observations are analyzed using software "students online t test". Significant effect is observed on heart rate and blood pressure for level $p < 0.05$. In high voltage powerline study, the changes in diastolic or systolic blood pressure and heart rate when volunteers were subjected to electromagnetic radiation due to power line for 30 minutes of time are statistically not significant for groups at level $p < 0.05$.

Keywords: Electromagnetic radiation (EMR), Mobile tower radiation, radiation pollution, HVPL study

INTRODUCTION

Speedy developments in various fields of science and technology in recent years have exaggerated the human interference into the natural environment. Such interference is linked with physical, biological and ecological systems resulting in various accidental and unwanted negative impacts on environment. With economic, social and scientific development, there is awareness about environmental pollution recent times. Everyday our life is encompassed by man-made EMR: food is heated in microwave ovens, airplanes are guided by radar waves, television sets receive electromagnetic waves transmitted by broadcasting stations, and infrared waves from heaters provide warmth. Infrared waves also are given off and received by automatic self-focusing cameras that electronically measure and set the correct distance to the object to be photographed. During night, incandescent or fluorescent lights are turned on to provide artificial illumination, and cities glow brightly with the colorful fluorescent and neon lamps of advertisement signs. Ultraviolet radiation cannot be seen by eye but its effect is felt like pain from sunburn. Mobile tower, cell phone and HVPL are also pouring radiation in these.

The intensity of man made EMR has become so ubiquitous and it is now increasingly being recognized as a form of unseen and dangerous pollution that might affect life forms in multiple ways [1]. Most of the short-term studies related to the thermal impacts of EMR exposure on biological systems have neither succeeded to discover any statistically significant changes in the biological processes at the background levels of exposures [2]. On the other hand, long-term studies have reported frightening observations, detecting negative consequences on immunity, health, reproductive system, behavior, communication and co-ordinations [3]. The electromagnetic radiations are classified in to radio frequency field (RFF), Intermediate frequency fields (IFF), extremely low frequency field (EFF) and static fields [4].

The consequence of mobile phone radiation and HVPL on human health is the subject of recent interest due to enormous increase in mobile phone usage

throughout the world. Mobile phones use EMR in the microwave range. Some national radiation advisory authorities have suggested actions to diminish exposure to their citizens as a preventive approach. The speedily growing mobile phone technology increased public anxiety about the possibility of associated undesirable health effects. There is some evidence for biological consequences also, which, may be necessarily hazardous for humans [5]. Radiation from mobile base stations (towers) may also have an effect on the local abundance of insects or other invertebrates and thereby indirectly influencing the number of house sparrows. The adult house sparrows are seed-eaters, and need insects and other invertebrates to feed their young, such that it is likely that they will prefer areas with high abundance of invertebrates at the beginning of the breeding period. Several investigators have postulated that the lack of invertebrates might be an important factor in the reported decline of house sparrow populations in urban areas. Short-term exposure of pulsed mobile phone radiation with carrier frequency 900 MHz resulted in a 50-60 % decrease of the reproductive capacity of insects. Similar results were also found with microwave radiation at other frequencies.

Some study showed that long-term exposure to low-intensity (pulsed) electromagnetic radiation from base stations may have significant effects on populations of wild birds. When birds are exposed to weak electromagnetic field, they disorient & begin to fly in all directions. This explains migratory birds undermining navigational abilities. Honey bees appear to be very sensitive to EMR [6]. Plant showed responses to high frequency electromagnetic fields [7]. Other wildlife such as amphibians and reptiles also appear to be at high risk with possible interference of EMR. Biological effects due to HVPL on plants, insects and animals, as well as the human body are less harmful when exposed to levels that are below the standardized threshold values. Probable risks from high voltage powerline like leukemia, breast cancer, neuropsychological disorders, decrease in blood sugar and reproductive outcomes have been reported [8,9].

METHODOLOGY

Caddo 19B Multipara Monitor with silver/silver chloride ECG disposable electrodes (single use) and ECG paper rolls are used for experiments. Multipara monitor machine is a light weight, compact and easily portable (Fig. 1). Using the machine one can view important signals such as electrocardiogram (ECG), respiratory rate, percentage of saturated oxygen (SpO₂), blood pressure and body temperature. These parameters can be easily displayed on monitor. The power switch is on the front side of panel. The charge marker and the power switches are illuminated when the machine is powered on. The alarm display is on the front panel. The alarm indicator shows lights when alarm takes place. The sensors have sockets at the left side and the recorder socket is at the right. Other sockets and power connectors are on the rear panel. The monitor is easy tool to use with functions carried out by a small number of buttons and a rotating switch on the front panel. The multipara monitor has a printer with network arrangement and provision to display patient's very important health parameters on the screen. The data so obtained is used for measurement of various parameters and keeping record for diagnosis and treatment. This data can be stored, printed and transferred. There are four sensors or electrodes, used in multiparameter which is capable of giving information of electrocardiogram and health parameters (Fig. 2).

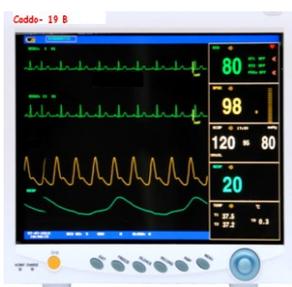


Fig1: Multiparamonitor Fig 2: Multiparameter electrodes

SAMPLE COLLECTION AND STUDY PLAN

For mobile radiation study, 20 students including males and females within age in between of 18-25 years were selected from urban backgrounds. These volunteers were using cell phones and enrolled in the

Colleges of Pune city. Any individual, employees, guest and servants were excluded from study. College students selected were using cell phone for more than 3 years. The purpose of study was explained to all volunteers and their consents were obtained.

All subjects were informed to avoid drinks like caffeinated drinks. They are also asked not to have unnecessary activities together with physical exercises and aerobatics within 12 hours prior the collecting data. They were also informed not to have food or tea prior to experiments. Volunteers were given information regarding the equipments being used for examining the health parameters, procedure of study and experimentation. Mobile study was completed in a silent, airy and spacious room in seating position. The recording of respiratory rate (RR), saturated oxygen (SpO₂) along with systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate (PR) and body temperature (Temp) of a volunteer under observation was completed with the help of simple six channel multipara monitor of Scientech Company of Model Caddo 19B.

ECG electrodes are positioned on arms, legs and chest as per standard medical practice or guidelines given in the user's manual provided by supplier of machine. Recording of ECG generally takes five to ten minutes for a single patient. After recording ECG, the electrodes positioned to body are removed from their locations. An ECG recording is absolutely trouble-free. A volunteer at fixed distance (100 m) was talking continuously on one mobile (Moto G 3rd Gen-XT 1550) with volunteer under experiment using another mobile GSM SIM (AIRCEL). Recording of various health parameters were also noted.

Same methodology was used for HVPL study except that volunteer was asked to sit below high voltage powerline.

RESULTS AND DISCUSSION

All the parameters indicated distinct trend in variations in the data except temperature parameter for mobile radiation emitted due to one hour communication. This was because the change in temperature was very small in magnitude as

compared with other parameters. It was observed that there were significant changes in HR and BP as compared with other health parameters. It had been noticed that after 20 minutes of exposure of cell phone radiation, health parameters under investigation showed a trend in the value of parameter. Hence time of exposure was kept time of 20 minutes for further observations. Figure 3 indicates comparative changes in health parameters after mobile phone radiation exposure of 20 minutes.

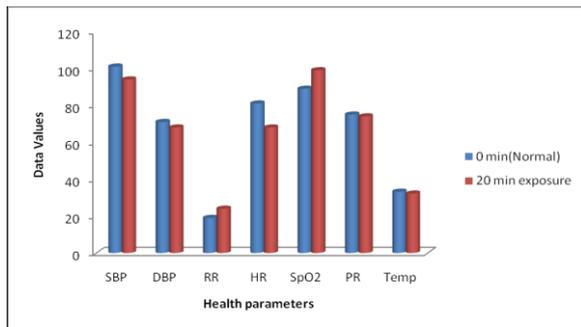


Fig 3: Typical variation in health parameter after 20 min of mobile communication of a volunteer. Heart rate is associated with BP. Observations from 20 volunteers were compared with un radiated normal values of health parameters. These values were compared using online “t test calculator”. Hence p values for blood pressure and heart rate are shown in Table 1.

Gender wise comparison of various parameters is shown in Table 1, showed that for male the variation in heart rate was significant at the level of $p < 0.05$, while in case of female volunteers the change in heart rate was not statistically significant. Similarly, observed variation in diastolic blood pressure is significant for female group.

Same observations were noted by asking volunteer to seat below HVPL. The statistical p values of these observations are indicated in Table 2.

Gender ↓	Age years	p value for heart rate for exposure of		p value for DBP for exposure of	
		10 min	20 min	10 min	20 min
Male	22±1.05	0.0273	0.0023	0.504	0.662
Female	21.67 ± 2.53	0.6303	0.2321	0.286	0.022

Table 1. Statistical p values for HR and DBP

The analysis carried from Table 2, indicated that the variations in diastolic BP, Systolic BP, HR, pulse rate, respiration rate and SpO2, when a volunteers were subjected to electromagnetic radiation due to powerline for 30 minutes was statistically not significant for groups at level $p < 0.05$. This results confirmed the study of other investigators [10].

Table 2. Min, Max, and S.D values of studied variables for male students before and after exposure to EMR from HVPL

Variables	For male				For female			
	Min.	Max.	S.D.	p value	Min.	Max.	S.D.	p value
SBP (a)	105	144	12.50	0.207	95	117	7.86	0.652
SBP (b)	101	121	10.28		110	100	9.38	
DBP (a)	61	89	13.41	0.952	60	91	9.62	0.592
DBP(b)	65	96	7.35		59	63	8.37	
RR (a)	14	21	2.97	0.931	14	21	1.93	0.267
RR (b)	18	12	2.02		21	11	3.03	
HR (a)	65	97	12.06	0.805	70	96	7.67	0.447
HR (b)	73	92	11.35		75	74	7.18	
PR (a)	73	104	12.0	0.196	73	94	8.17	0.760
PR (b)	87	86	6.50		78	73	6.13	
SpO2(a)	84	99	4.41	0.469	73	98	6.63	0.0923
SpO2(b)	90	98	2.63		95	97	1.25	

CONCLUSION

In the study of continuous communication on the mobile phone reported, it had been observed that the call with a mobile phone changed heart rate of healthy volunteer. Mobile phone radiation affected heart rate variability but the effect of speaking on mobile phone cannot be ignored. The result indicated increase HRV parameters even near to head while taking for 20 minutes. Analysis of the data showed statistical significant effect due to mobile phone exposure of 20 minutes on health parameters. The HVPL study indicates that there is no significant effect of powerline voltage on health parameters measured in heart rate variability. The results due to fact that frequency of powerline is of 50 Hz only, hence it possess low energy. Human body absorbs energy of high frequency field more easily. Cells within body possess bioelectric field due to bioelectric potentials.

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