

# Epidemiological Survey on Effect of Emf Emitted by Cell Phones Used in Dhaka City Bangladesh

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**Abstract**— The Significant concerns has been raised about possible health effects from exposure to radiofrequency (RF) electromagnetic fields specially after the rapid introduction of modern amenities like the mobile telecommunication systems. There are many epidemiological studies of the possible adverse health effects associated with environmental exposure to extremely low frequency (0-300 Hz) non-ionizing radiation such as that emitted by power cables and electrical substations linking such exposure to leukemia, brain cancer, male breast cancer, skin cancer and eye melanoma. Far less attention has been paid to health hazards from environmental exposure to radiation in RF range (100 kHz-300GHz) at field strengths much below to these required to produce thermal effects. Laboratory studies in this area have also been confusing and conflicting. While some animal studies suggest that RF fields accelerate the development of cancers, other studies found no carcinogenic effect. There is an urgent need for extensive, well conducted epidemiological and laboratory studies. Cell phones are being used all over the world as it has made the life easy for all walks of life including academic, office, and business. Millions of cell phones are also being used in Bangladesh. EMF is also emitted by cell/mobile phones. There has been no such study performed in Bangladesh. The data were collected from various places in Dhaka city, Bangladesh. Both Electric and Magnetic fields were measured for cell phones. Both epidemiological survey and EMF measurements were done for these cell phones. These results showed that in many cases the magnetic field radiated from the different sources are greater than the threshold limit and cell phone users suffered from various types of ailments insomnia, pain in hands, headaches etc. due to prolonged exposure to EMF. Also smoking contributed to their overall health problems.

**Index Terms**— EMF, ELF, EF, MF, NIR, WHO

## 1 INTRODUCTION

Ionizing radiation is the radiation of sufficiently high energy to cause ionization in the medium through which it passes. It may consist of a stream of high-energy particle (e.g. electron, protons, alpha particles) or short wavelength electromagnetic radiation (ultraviolet, X-rays, gamma-rays). Radiation, which does not cause any ionization of the media while passing through it, is known a non-ionizing radiation (NIR). Examples of non-ionizing radiation are ultraviolet, visible light, infrared, microwave and radiowave. Their energy is relatively low; it only manages to cause molecules to vibrate and induces heating effects.

Exposure to Extremely Low Frequency (ELF) electric and magnetic fields does produce biological effects. However, except for fields strong enough to induce current densities above the threshold for the stimulation of nerve tissue, there is no consensus as to whether these effects constitute a hazard to human health. Human data from epidemiological studies, including reported effects on cancer promotion, congenital malformations, reproductive performance and general health, though somewhat suggestive to adverse health effects, are not conclusive. Since magnetic field is more harmful than electric field, there must be a limit both in the residential and occupational levels between 0.2 to 0.3  $\mu\text{T}$  or 2.5 mG. (This value is internationally recognized as standard limit in many countries). Also, for electric field this value is 25V/m. It must be ensured that intensity of radiation in the body does not exceed

the recommended maximum level (10 mW/cm<sup>2</sup>, 195V/m in U.S.A. and 0.1 mW/cm<sup>2</sup>, 20 V/m in CIS). These human made electric and magnetic fields (typically 25 V/m and 2.5 mG or 0.25  $\mu\text{T}$ ) are substantially above the naturally occurring ambient electric and magnetic fields of 10-4 V/m and 10-13 T respectively[1-2].

Lower animals are reported to very much sensitive to electromagnetic fields. It is observed that animals like rats make their living brooding holes away from the high electric field and bees block-up their hives in the chronic presence of NIR/EMF. As a consequence, scientists and health physicians in developed countries have become aware of the effects of NIR [3]. Their research and observations have brought out some remarkable results linking low level alternating electromagnetic fields with serious health hazards. There is also evidence that biological effect like immune deficiency, sensitive lymphocytes, disrupting DNA, cellular breakdown is being affected by NIR [4].

Much research has been performed in this regard. Most recently, Epidemiological survey of people working in EMF field exposed to high frequency have been investigated [5]. Also, research was performed for epidemiological survey on effect of EMF emitted by photocopy machines generally used in Dhaka city Bangladesh [6]. Survey was done on EMF emitted by Lab equipments in various labs of Southeast University in Bangladesh for possible health hazards [7]. A case study was done on EMF near high voltage transmission line [8].

Also, a review was done on Non Ionizing Radiation (NIR), its harmful effects especially from Mobile/Cell Phone and Towers [9]. An epidemiological survey was performed on CRT monitors used in Dhaka city [10]. An investigation was performed in finding the magnetic field emitted from various Lab equipments in Textile Labs in Southeast University [11]. A case study was done on EMF near high voltage transmission line [12]. Measurement of EMF was also done on Pharmacy Lab equipments in Southeast University [13]. Magnetic Field measured from Electrical Appliances in EEE Classrooms of Southeast University Bangladesh were performed [14]. Measurement of magnetic field emitted from electrical appliances in CSE Labs and classrooms of Southeast University, Bangladesh were done [15]. Measurement of magnetic field Emitted from lab equipments and electrical appliances in ETE labs of Daffodil International University, Bangladesh were also performed [16]. Health effects of EMF emitted from cell phoned used by Southeast University students Dhaka, Bangladesh were also examined [17].

There have been various papers published on EMF of radio, TV etc. but not much on cell phones. Since the invention of modern cell phones there has been tremendous increase in use of air conditioning in the world. Phone calls, texting, video conference, internet etc. are all various common features of cell phones. The use of mobile phone is increasing every day numbering more than 8 billion according to International Telecommunication Union (ITU) [18]. Due to increase in use, many health symptoms due to cell phone radiation show up early on and precede more serious disorders and diseases. They include; chronic cold and flu, headache and mind fog, digestive disorders, sleep disturbance, memory loss, depression/ anxiety, chronic pain, dizziness. etc. [19]. Intensity of radiation Maximum Permissible Dose (MPD) does not exceed: 10 mW/cm<sup>2</sup>, 195 V/m in USA and 0.1 mW/cm<sup>2</sup>, 20V/m in CIS. WHO recommends: 2.5 mT MF, 0.2-0.3  $\mu$ T and 25 V/m EF, 200-300 nT [20] [21]. Mobile phone exposure can lead to cancer, other health effects, electromagnetic interference, and traffic accidents. [22] Mobile/cell phones can also carry germs [23].

Small text and bright screens can strain mobile phone users' eyes. Since tablet computers, smartphones, and other handheld devices are designed for reading at close range, users' eyes must constantly refocus and reposition to process the graphics and text on screen. As digital use increases, so do potential vision problems, including eye strain. Symptoms of digital eye strain include eye redness or irritation, dry eyes, blurred vision, neck pain, back pain, and headaches. A study conducted discussed about cell phone and cataract [24]. In 2011, the World Health Organization (WHO) labeled mobile phones as a "carcinogenic hazard" [25].

Especially in tropical countries like Bangladesh, it is in high demand not only at offices, but at homes also. With the increase in the efficiency of the cell phones as well as the attractive decrease in its price, most adult persons in Bangladesh have their own cell phones. The number of mobile phone sub-

scribers in Bangladesh has reached 121.860 million at the end of January 2015 [26] and according to the telecoms regulators, the number of mobile subscribers was a little over 130.8 million by the end of August 2015, as per the sale of SIM cards [27]. The aim of this research is to investigate whether the EMF emitted from these mobile/cell phones are within threshold values and also if the users are safe from these equipments.

## 2 MATERIALS AND METHODS

A magnetic Science International MF meter was used for measuring the magnetic field values for the various air conditioners and switch board equipments. This is a single-axis gaussmeter to measure AC magnetic fields from power lines, home and building wiring, and appliances. Its single-axis detachable probe have frequency range 33 Hz - 2000 Hz, maximum field of 50,000 mG with resolution 0.1 mGA [28]. Coghill Field Mouse for Biohazard Awareness was used for measuring the threshold values for both electric field (EF) and magnetic field (MF) around the instrument. The readings were taken to cover all around the equipment. The method followed was: at the center of the equipment (front side), right side, and left side of the equipment.

## 3 RESULTS

Findings at different EMF sources: All the readings were taken from various locations from Dhaka. Readings were taken from various cell phones owned by students.

### 3.1 Epidemiological data from cell phones

Table 1 gives epidemiological data taken from the cell phones studied. The cell phone users' ages are given, along with number of years using cell phone, hours per day usage, smoker/non-smoker, symptoms using cell phones, and any other comments or observations. The age of the users in this study ranged from 19-26 years. Cell phone usage ranged from 1 month up to 8 years. Also, cell phone usage ranged from 30 minutes to 24 hours per day. The users were categorized as smokers or non-smokers. It was found that except two, all other users were non-smokers. The two smokers smoked 2 times per day. Amongst the symptoms, it was found that the users suffered from Insomnia, headache, pain in hands, fatigue, warmth behind ear, memory loss etc. It was interesting to find that in two cases, there were no symptoms: (1) A user using phone for only 30 minutes per day with 2 years usage, and (2) another user only started using it for 1 month and used for 10-12 hours per day. Most possibly their cell phone usage for short time per day and short time usage prevented from these 2 users from developing any adverse symptoms. Eight of the users mentioned they were aware of EMF adverse effects, and the rest said were not aware of it.

**Table 1:** Epidemiological survey of Cell phone users at Dhaka, April 2017

S.N.	Age (years)	Usage years	Usage Hours/day	Smoker?	Symptoms	Other observations
1	22	3 years	24	No	Pain in hands	Not aware of any EMF effects due to cell phone usage
2	22	1 year	10	Yes, 2/day	Pain in hands	Not aware of any EMF effects due to cell phone usage
3	22	2 months	11	No	Headaches	Not aware of any EMF effects due to cell phone usage
4	23	2 years	8	No	Insomnia	Not aware of any EMF effects due to cell phone usage
5	20	6 years	10	No	Headache	Yes, aware of any EMF effects due to cell phone usage
6	21	8 years	11	Yes, 2/day	Insomnia	Yes, aware of any EMF effects due to cell phone usage
7	21	1 year	12	No	Insomnia	Yes, aware of any EMF effects due to cell phone usage
8	24	2 years	8	No	Fatigue, headaches	Not aware of any EMF effects due to cell phone usage
9	22	1.5 years	8	No	Insomnia	Yes, aware of any EMF effects due to cell phone usage
10	22	6 months	12/13	No	Headaches	Not aware of any EMF effects due to cell phone usage
11	22	6 months	12	No	Fatigue, warmth behind ear	Yes, aware of any EMF effects due to cell phone usage. But could not avoid using it.
12	26	2 years	30 minutes	No	None	Not aware of any EMF effects due to cell phone usage
13	23	6 months	12 hours	No	Memory loss, headaches	Yes, aware of any EMF effects due to cell phone usage. But could not avoid using it.
14	20	12	20	No	Headaches	Yes, aware of any EMF effects due to cell phone usage.
15	19	1 month	10-12	No	None	Yes, aware of any EMF effects due to cell phone usage. But it is a necessary thing.

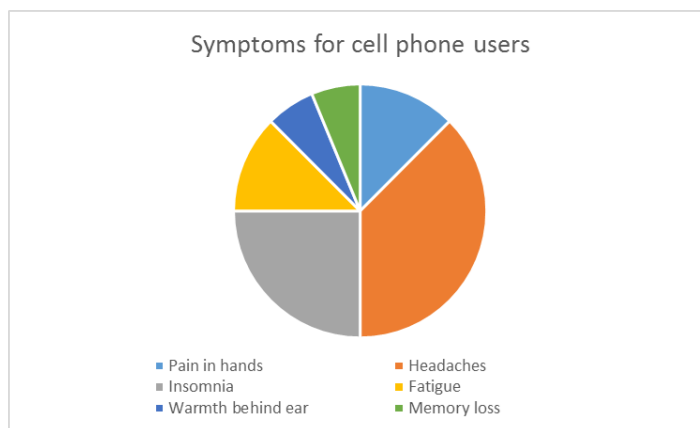


Figure 1. Symptom occurrences for cell phone users.

Table 2: EMF values measured for cell phones in Dhaka, April 2017.

Serial No	Equipment info. (Machine #, Machine Model, made country, year made, Date of installation)	Threshold dis. in front of the equipment measured from the center of the equipment (cm)		Magnetic Field maximum (mW/cm <sup>2</sup> )	Magnetic Field maximum (mG)
		Electric field (EF)	Magnetic field(MF)		
1	Walton Primo GH3 Bangladesh	10 cm	20 cm	162.2	67.87
2	Lenovo Vibe Android China 2016	7	16	19.1	7.99
3	Huawei Y6 Pro 16 GB Rom, 2 GB RAM, 3100 Mah China 2016	6	15	18.2	7.62
4	Walton Primo H2 Android BD 2015	8	15	87.5	36.61
5	Symphony P6 Android China 2015	18	25	110.5	46.23
6	Motorola G6 Android China 2015	10	21	191.62	80.18
7	HTC Desire Eye Android Taiwan 2014	8	15	67.5	28.24
8	Samsung S6 Android South Korea 2014	15	22	130.43	54.57
9	Microsoft Lumia 640XL Windows Vietnam 2015	8	18	161.5	67.57
10	Oppo F1 Plus Android China 2016	12	20	364.4	152.47
11	Walton G6 Android Bangladesh	15	20	122.2	51.13
12	Samsung R style Royel Korea	10	20	42.4	17.74
13	Xiaomi Redmi 3 pro Android China	6	22	183.5	76.78
14	Samsung ACE2 Android China	16	28	188.3	78.79
15	Motorola G8 Android China 2016	6	11	180.42	75.49

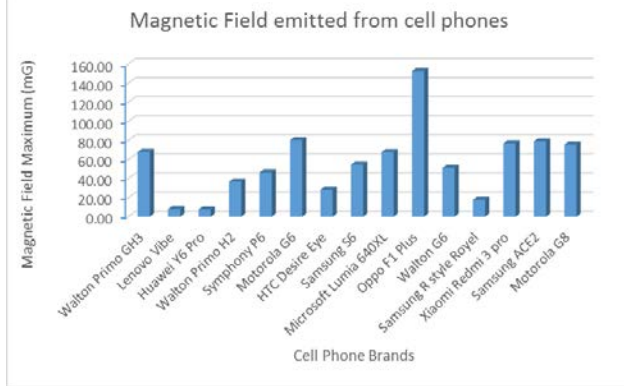


Figure 2. Graphic representation of Table 2 for magnetic field in mG.

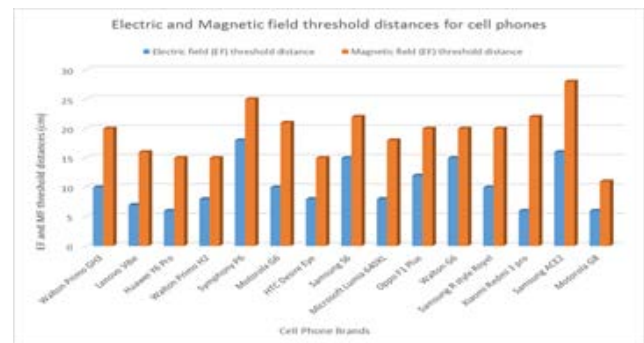


Figure 3. Electric and Magnetic Field threshold distances from various cell phones in cm.

## 4 DISCUSSIONS

It was found from the results that the magnetic field values are higher in some cases than the threshold level. Nearly all of the cell phones studied were manufactured recently (starting from 2014 to 2017) i.e. the users used it for a short duration of time, also there were not many cell phones included in the study of various brands. The users were in the age ranges from 19 to 26 years. We have in mind to include more cell phones of various brands, phones with long time usage by the same user, user with higher age range, and cell phones manufactured and used for a long duration of time period, and also other regions of Bangladesh for the study to continue.

There has been an increase of use of the cell phone usage in Bangladesh for the last few years in both urban and rural settings to increase the working efficiency of the people. People of all age ranges and economic backgrounds are using cell phones without knowing the adverse side effects due to EMF.

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## 5 CONCLUSION

From the above cell phone data it has been found that in some cases the magnetic field has crossed threshold value. The electric field also has a higher threshold value in some of the equipments. Also, the magnetic field maximum exposure was nearly 152.47 mG in one case. Cell phone categories have different magnetic field values and also their date of manufacturing and usage. The safe distance for use of cell phone is 1" or 2.54 cm. Users are advised to use a hand free device which places more distance between the phone and the head of the user. People should try to use their cell phones a bit far from their heads (ear) beyond the threshold values, best if using hands free device, decrease the duration of time of speaking, as well as using a well covered area for talking. Also, texting can be done wherever necessary instead of talking. It is hoped that this survey will be helpful as a preventive health measure for people using cell phones in Dhaka city.

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