



SURVEY OF EMF EMITTED BY DOMESTIC APPLIANCES IN DHAKA

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ABSTRACT

This research aims to explore if the electromagnetic fields (EMF) released by numerous domestic appliances affects the people. There is a typical threshold value for electric and magnetic fields endorsed by the World Health Organization (WHO). Electro-Magnetic Fields can instigate health risks to a living organism. There has been no such study performed in Bangladesh on domestic appliances. The data were collected from various home appliances in different locations in Dhaka, Bangladesh: Baridhara, Shyamoli, Mirpur, and Shakher tek. Both threshold values of electric and magnetic fields, as well as magnetic field values, were measured for several electrical and electronic appliances. Results obtained from magnetic field maximum values revealed that in numerous instances the magnetic field released from the various devices had exceeded the threshold limit.

Keywords: EMF, WHO, NIR, EF, MF.

INTRODUCTION

Ionizing radiation is the radiation of adequately high energy to instigate ionization in the medium. It can comprise a stream of high-energy particle (e.g., electron, protons, alpha particles) or high-frequency electromagnetic emission (ultraviolet, X-rays, gamma-rays). Radiation which does not produce any ionization of the passing medium is non-ionizing radiation (NIR). Radiowave, microwave, infrared, visible light, ultraviolet are examples of NIR. Their energy is relatively low, only triggering molecules to vibrate and stimulates heating effects.

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. Fields at radio frequencies from 300 kHz to 300 GHz are measured in electric field strength (V/m) and magnetic field strength (A/m). At frequencies higher than 300MHz, power density (W/m^2) is usually used in hazard evaluation. Except for field far from sources, both the electric field (EF) and the magnetic field (MF) may have to be measured for a complete specification. There is an unsubstantial report on the effects of RF radiation on man and limited data on reactions of animal unprotected to frequencies higher than 10 GHz and lower than 10 MHz; most animal research has been carried out at frequencies near 3 GHz. People who are working in the power sub-stations, radio and T.V. transmitters should be cautious to protect their eyes and should always maintain safeguarded space from the transformers and panels, especially from the modulation panel (Minimum 3 feet/ 90 cm). Since the magnetic field is more detrimental than the electric field, there must be a threshold both in the occupational and residential levels between 0.2 to 0.3 μT or 2.5 mG. (This value is internationally documented as a standard limit in many countries). Also, for the electric field, this value is 25V/m. Nevertheless, for the person working at very high frequency transmitting stations, safely protections, e.g.,

wearing of secured goggles, screened helmets and unique clothing should be done. The length of exposure should be kept minimum possible. The intensity of radiation in the body should not surpass the recommended maximum limit (10 mW/cm², 195V/m in the U.S.A. and 0.1 mW/cm², 20 V/m in CIS).

Nancy Wertheimer was the first scientist to identify the connection linking magnetic fields and childhood leukemia [1]. It is stated that high power transmission lines [2-3], computer monitor, radio waves of various frequencies in telecommunication, radar, satellite, etc. also instigate damage to living organisms [4-5], particularly in humans. It is known that high power transmission lines cause human health risks. Also, there are confirmations that the reason for suicide and clinical depression are linked with the radiation from the power lines [6-7]. A substantial fraction of miscarriage is documented amongst women using electric blankets, electric waterbeds and computer monitor. There are instances that occupational hazards, e.g., Acute Myeloid Leukemia (AML) may occur amongst the individuals employed in the area of telecommunication. Also, it is found that suppression of T- lymphocyte cell, cancerous thyroid tumor, etc. may arise amongst the publics unprotected to NIR. Small animals are informed to be very sensitive to EMF. It is observed that animals, e.g., rats build their (living offspring) holes away from the high electric field and bees shield their hives in the chronic presence of NIR/EMF. As a result, research communities in developed countries have been conscious of the consequences of NIR [8]. Their findings have given some fantastic outcomes linking low-level alternating EMF with grave health risks. It is alleged that the reason for Sudden Infant Death Syndrome (SIDS) may have some link to EMF. Also, there is proof that biological effect like sensitive lymphocytes, disrupting DNA, immune deficiency, the cellular breakdown is being influenced by NIR.

There are some biological effects due to EMF where these fields are higher than the naturally arising



electric and magnetic fields $\sim 10^{-4}$ V/m and $\sim 10^{-13}$ T respectively [9]. EMFs could influence the creation of agents (e.g., free radicals), which themselves can interact with DNA or other agents that trigger chromosomal damage, initiating translocation by prompting DNA breaks or by the creation of abnormal DNA structures. Strains of Salmonella uncovered to 15 or 30 mT magnetic fields at 0.3 Hz, 1-10 μ T sinusoidal magnetic fields at 50 Hz applied in 2 μ s pulses or to a various range of radio frequency and microwave fields exhibited no increase in mutational frequency [10]. Fields (0.2 mT) at 60 Hz have been informed to be mutagenic in Salmonella, causing a 14% increase in azide-induced mutations after 48 h exposure [11]. Human lymphocytes uncovered to sinusoidal 50 Hz, 60 Hz, or pulsed EMFs did not show noticeable chromosomal variations or inhibition of DNA repair mechanisms [10], [12-17]. Primary human lymphocytes have been stated to display amplified micronuclei formation when open to 75 or 150 μ T fields at 32 Hz, but only when a parallel 42 μ T d.c. field was applied alongside to create the cyclotron and paramagnetic resonance state for calcium [18], it increases in chromosome defects in human amniotic cells unprotected to an incessant or recurrent 30 μ T sinusoidal field at 50 Hz [19]. Uncovered to ionizing radiation, trailed by 60 Hz magnetic fields as high as 1.4 mT, boosted the frequency of near-tetraploid chromosome complements in human peripheral blood lymphocytes [20], a result not observed only with ionizing radiation. Adverse effects have been seen in whole-animal reports: to escalate the frequency of dominant lethal mutations in male mice was unsuccessful with 50 Hz electric fields (20 kV m^{-1}), and 60 Hz fields of as much as 50 kV m^{-1} with magnetic fields as high as 1 mT did not affect the frequency of sister chromatid swap in mouse bone marrow [21-22]. Therefore, there are some reports of positive EMF effects.

Some research has been accomplished in this aspect. Epidemiological survey of public working in EMF field unprotected from high frequency have been explored [23]. Also, an epidemiological study was done on EMF produced by photocopy machines in Dhaka [24]. A survey was done on EMF by Laboratory appliances in Southeast University laboratories in Bangladesh [25]. A case study was done on EMF closeness to high voltage transmission line [26]. A review was performed on NIR and its harmful effects (mobile/cell and towers) [27]. An epidemiological study was done on the Cathode Ray Tube (CRT) monitors in Dhaka [28]. An investigation was performed in finding the magnetic field emitted from various Lab equipment in Textile Labs at Southeast University [29]. EMF was also measured on Pharmacy Lab appliances in Southeast University [30]. Magnetic Field measured from Electrical equipment in Southeast University Bangladesh EEE classrooms were performed [31]. The magnetic field from electrical equipment in CSE laboratories and classrooms of Southeast University, Bangladesh were done [32]. The magnetic field from the lab and electrical appliances in ETE laboratories in a private University in Bangladesh were also measured [33]. EMF from cell phones used by Southeast University students in Dhaka, Bangladesh was

also examined [34]. EMF produced from switchboards, and air conditioners of another private University at Dhaka in electrical and electronic engineering labs were also computed [35]. An epidemiological survey has also been performed on EMF produced by cell phones in Dhaka [36].

There have not been many articles available on EMF on domestic electrical appliances. The home dwellers are being exposed to these appliances 12-24 hours per day. The objective of this effort is to save the population who would be near to these and operating on this equipment shortly from the destructive effects of EMF.

METHODS

A Magnetic Science International MF meter (Serial 624335) was used for computing the magnetic fields for the lab equipment. A Coghill Field Mouse for Biohazard Awareness was utilized for measuring the threshold values for both magnetic and electric fields around the equipment. Dr. Roger Coghill (UK) was the designer of this equipment. The students completed the tables for measuring the equipment. The data were procured to cover all around the equipment.

RESULTS

All the readings were taken from numerous domestic appliances from various locations in Dhaka city Bangladesh. In Table-1, experimental data were collected from multiple sites in Dhaka for micro-oven, water-heater and table lamps.

Data were taken for five microwave ovens, five water heaters, and 5 table lamps. The EF threshold distance in front of the micro-ovens ranged between 38 and 65 cm, threshold distance at 45° angle from the frontal surface ranged from 11 to 25 cm, Threshold distance at the back of the instrument ranged from 26 to 48 cm, and threshold distance at the top of the device ranged from 14 to 21 cm. The MF threshold distance in front of the micro-ovens ranged between 17 and 34 cm, threshold distance at 45° angle from the frontal surface ranged from 4 to 12 cm, threshold distance at the back of the instrument ranged from 7 to 21 cm, while threshold distance at the top of the device ranged from 8 to 17 cm. The EF threshold distance in front of the water heaters ranged between 42 and 60 cm, threshold distance at 45° angle from the frontal surface ranged from 41 to 58 cm, threshold distance at the back of the instrument ranged from 42 to 58 cm, and threshold distance at the top of the device ranged from 42 to 58 cm. The MF threshold distance in front of the water heaters ranged between 12 and 27 cm, threshold distance at 45° angle from the frontal surface ranged from 12 to 26 cm, threshold distance at the back of the instrument ranged from 11 to 23 cm, while threshold distance at the top of the instrument ranged from 10 to 21 cm. The EF threshold distance in front of the table lamps ranged between 29 and 46 cm, threshold distance at 45° angle from the frontal surface ranged from 11 to 16 cm, threshold distance at the back of the instrument ranged from 14 to 28 cm, and threshold distance at the top of the instrument ranged from



17 to 21 cm. The MF threshold distance in front of the water heaters ranged between 5 and 8 cm, threshold distance at 45°angle from the frontal surface ranged from 4 to 11 cm, threshold distance at the back of the

instrument ranged from 5 to 8 cm, while threshold distance at the top of the instrument ranged from 5 to 7 cm. Figure-1 gives the EF and MF threshold distances from those appliances, data from Table-1.

Table-1. Threshold Distances for electric and magnetic fields from micro-oven, water-heater, and table-lamp.

Instrument	Index	Threshold distance in front of the instrument (cm)		Threshold distance at 45° angle from the frontal surface (cm)		Threshold distance at the back of the instrument (cm)		Threshold distance at the top of the instrument (cm)	
		EF	MF	EF	MF	EF	MF	EF	MF
Micro Oven	1	59	21	20	7	37	18	17	11
	2	47	20	19	8	40	18	19	14
	3	65	34	25	12	48	21	21	17
	4	38	17	11	4	33	7	17	8
	5	43	23	17	12	26	13	14	8
Water Heater	1	42	13	42	12	43	12	42	10
	2	57	27	57	19	58	17	57	19
	3	41	12	41	13	42	11	42	10
	4	57	21	57	21	58	22	58	19
	5	60	26	58	26	56	23	58	21
Table Lamp	1	33	8	16	7	26	6	18	7
	2	46	5	13	4	23	7	21	7
	3	29	6	13	11	28	7	17	7
	4	36	7	10	6	14	5	19	6
	5	31	8	11	7	22	8	17	5

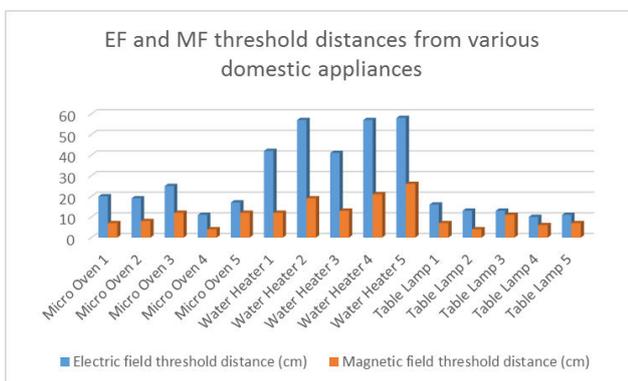


Figure-1. EF and MF threshold distances taken from the center of the equipment for the various micro oven, water heater, and table lamps appliance in Dhaka. Data were taken from Table-1.

Table-2 shows electric and magnetic field threshold distances from various television screens. The television screens consisted of Philips (color, black & white), Sony (color), National (color), and Tanin (color, black & white) brands. The electric field threshold distance in front of the table lamps ranged between 34 and 61 cm, threshold distance at 45°angle from the frontal surface ranged from 76 to 132 cm, threshold distance at the back of the instrument ranged from 85 to 130 cm, and Threshold distance at the top of the instrument ranged from 12 to 38 cm. The magnetic field threshold distance in front of the water heaters ranged between 13 and 23 cm, threshold distance at 45°angle from the frontal surface ranged from 26 to 76 cm, threshold distance at the back of the instrument ranged from 32 to 99 cm, while threshold distance at the top of the instrument ranged from 9 to 27 cm. Figure-2 gives the EF and MF threshold distances from those appliances, data from Table-2.

**Table-2.** Threshold distance from various television screens.

Television / screen size	Threshold distance in front of the screen, measured from the center of the screen (cm)		Threshold distance at 45° angles from the normal at the center of the screen (cm)		Threshold distance at the back (cm)		Threshold distance at the top (cm)	
	EF	MF	EF	MF	EF	MF	EF	MF
Philips 24" color	61	21	132	65	119	68	32	27
Philips 20" color	48	20	113	63	122	62	28	25
Philips 24" black & white	60	17	130	58	130	67	32	21
Philips 20" black & white	39	17	107	56	112	99	28	23
Sony 20" color	34	13	76	26	85	32	12	9
National 24" color	36	15	98	42	108	43	13	12
Tanin 17" color	37	21	103	76	120	78	25	23
Tanin 20" black & white	48	23	85	68	103	98	38	17

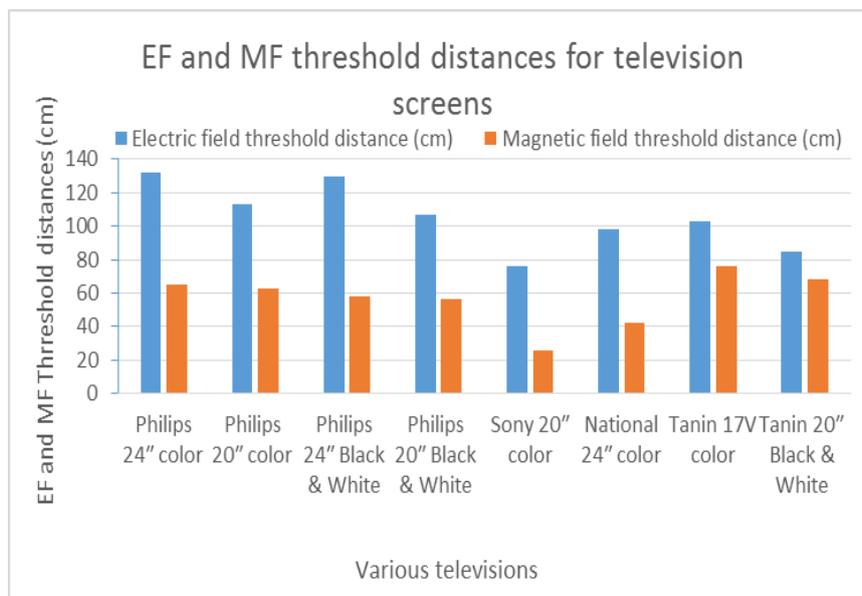
**Figure-2.** EF and MF threshold distances taken from the center of the equipment for various televisions in Dhaka. Data were taken from Table-2.

Table-3 shows electric and magnetic field threshold distances as well as magnetic field values on domestic appliances in a residential place at Baridhara, Dhaka. Threshold distance in front of the instrument (cm), threshold distance at 45° angle from the frontal surface (cm), threshold distance at the back of the instrument

(cm), threshold distance at the top of the instrument (cm), also magnetic field in front, back, 45° angle left and right were measured. Microwave Oven, Mobile charger, Nokia Model, Travel adaptor, Sony TV was measured for this readings. Figure-3 gives the maximum MF values for those appliances, data from Table-3.



Table-3. Threshold distances for electric and magnetic fields and magnetic fields radiated from domestic appliances from a residence in Baridhara, Dhaka.

Instrument	Threshold distance in front of the instrument (cm)	Threshold distance at 45° angle from the frontal surface (cm)	Threshold distance at the back of the instrument (cm)	Threshold distance at the top of the instrument (cm)	Magnetic Field (mG)		
					Front	Back	At 45°
Microwave Oven (Just on) no load	30 cm (door)	30 cm	20 cm	70 cm	Body touch 874 (door) 200mG LHS 170 center 140 RHS	Top 900 center 300 back	400
Mobile charger AC 3E/ME16 PCT Input 240V/100mA (50-60Hz) output 5V/350mA Made in China	15.4 cm	15.4 cm		10.5 cm	124	948	122
Nokia Model AC20E Input 100-240V Output 5V/750mA 100-240V/100mA	8 cm	8 cm	7.6 cm	8.9 cm	35	850	26
Travel adaptor (Samsung) Model ETAOU 80EBE Input 100-240V/0.15A Output 5V-1A/1000mA Made in China	30 cm	30 cm	15 cm	9 cm	-	-	-
SONY (BRAVIA) 3 years old	2-3 cm	0	0	0	26 mG on screen	-	-

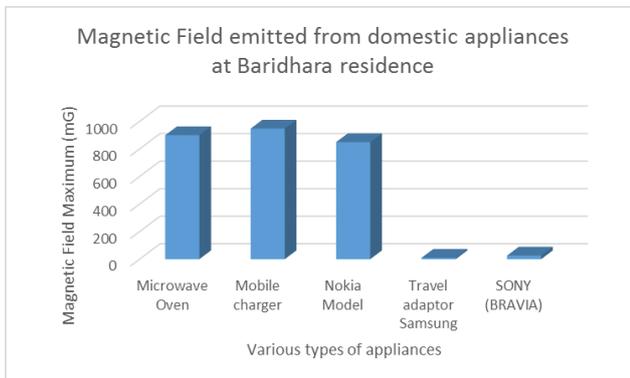


Figure-3. Graphical representation of magnetic field maximum values (mG) from Table-3.

Table-4 shows home appliances from a residential area in Shyamoli, Dhaka. Television, microwave oven, deep freezer, refrigerator, water heater, hair dryer, IPS, switches were measured for this location. Threshold distance in front of the instrument (cm), Threshold distance at 45° angle from the frontal surface (cm), Threshold distance at the back of the instrument (cm), Threshold distance at the top of the instrument (cm) and Magnetic Field (mG) Maximum values were measured for these appliances. Figure-4 gives the maximum MF values for those appliances. These data were taken from Table-4.



Table-4. Threshold distances for electric and magnetic fields and magnetic fields radiated from domestic appliances from a residence in Shyamoli, Dhaka.

Instrument	Threshold distance in front of the instrument (cm)	Threshold distance at 45° angle from the frontal surface (cm)	Threshold distance at the back of the instrument (cm)	Threshold distance at the top of the instrument (cm)	Magnetic field (mG) maximum
Television Konka	25	36	35	10	31
Microwave Konka	24	29	27	20	990
Deep Freezer Walton	40	38	32	24	274
Refrigerator Singer	31	30	28	21	702
Water Heater	14	15	10	6	108
Hair Dryer	11	10	8	5	914
Switch 1	6	7	5	2	379
Switch 2	5	5	4	1	275
IPS	44	45	40	31	2

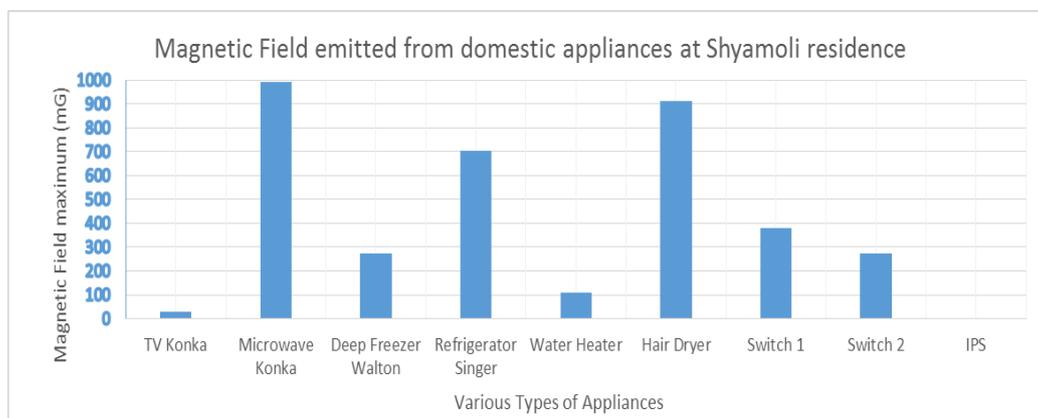


Figure-4. Graphical representation of magnetic field maximum values (mG) from Table-4.

Table-5 shows home appliances from a residential area in Mirpur, Dhaka. Television, washing machine, deep freezer, refrigerators, and electric iron were measured for this location. Threshold distance in front of the instrument (cm), Threshold distance at 45° angle from

the frontal surface (cm), Threshold distance at the back of the instrument (cm), Threshold distance at the top of the instrument (cm) and Magnetic Field (mG) Maximum values were measured for these appliances at this location.



Table-5. Threshold distances for electric and magnetic fields and magnetic fields radiated from domestic appliances from a residence in Mirpur, Dhaka.

Instrument	Threshold distance in front of the instrument (cm)	Threshold distance at 45° angle from the frontal surface (cm)	Threshold distance at the back of the instrument (cm)	Threshold distance at the top of the instrument (cm)	Magnetic field maximum value (mG)
Refrigerator Walton 2016	20	22	18	12	2
Refrigerator MyOne VIP-28(N) Malaysia 2015	25	24	19	14	8
Deep Freezer 1986	45	46	37	29	4
Electric Iron Philip, Comfort 216, 2000	33	32	27	22	12
Washing machine Samsung WA75K1 5.5 kg, 2003	23	25	21	17	5
Television My One, Delux-21D1, 2015	40	38	29	25	12

Table-6 gives threshold values of EF and MF as well as the magnetic field of home appliances taken from a location at Shakhertek, Dhaka. Equipment info (Machine #, Machine Model, made the country, year built, Date of installation), Threshold dis. in front of the equipment measured from the center of the equipment (cm), Magnetic Field (μT) in front of the equipment, Threshold dis. at right side of the equipment (cm), Magnetic Field (μT) at

right side of the equipment, Threshold distance at the left side of the equipment (cm), Magnetic Field (μT) at left side of the equipment, and Magnetic Field maximum (μT) values were measured for these appliances. The appliances measured were: Refrigerator, Energy bulb, Water Refresher, Television, LED LG Split AC Remote, Nokia charger, Charger-2, LG stereo Headset, Router, and Microwave oven.



Table-6. Threshold values of EF and MF as well as the magnetic field of home appliances taken from a location at Shakhertek, Dhaka.

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 (mG) in front of the eqpt.	Threshold dis. at the right side of the equipment (cm)		Magnetic field (mG) at the right side of the eqpt.	Threshold distance at the left side of the eqpt (cm)		Magnetic field (mG) at the left side of the eqpt.	Magnetic field maximum (mG)
	EF	MF		EF	MF		EF	MF		
SINGER Refrigerator SR4000SS	18	25	86	15	27	80	14	27	43	96
Energy bulb TRANSTAC	27	60	147	23	55	132	20	51	131	183
Water Refresher PURESIP Taiwan	22	30	129	27	35	123	25	30	122	168
Television SONY R510C1080P, LED	25	35	130	8	12	58	8	14	67	131
LG Split AC Remote	6	15	16	5	13	14	3	11	10	19
Nokia charger Asha 503 battery charger	8	12	177	4	6	106	4	6	105	195
Charger-2 Huawei GR5 mini battery charger	6	8	163	6	8	122	6	8	142	188
LG stereo Headset	6	12	129	4	10	23	4	10	146	156
Router TP-LINK, TL-WR841N	18	30	183	14	26	167	14	27	152	196
OVEN Conion Bc 23EBv microwave oven	25	35	170	15	25	156	12	25	144	191

Table-7 gives Threshold values of EF and MF as well as the magnetic field (maximum values) of home appliances taken from various cell phone chargers in Dhaka. Eight different chargers were investigated: Xiaomi, Nokia, Samsung, HTC, ASUS, Oppo, and Huawei. The magnetic fields ranged between 12 mG to 233 mG. The highest magnetic fields were found for

Xiaomi brand charger with 233 mG, while the lowest was for Nokia brand having a magnetic field of only 12 mG. ASUS brand charger also was above 100 mG having 175 mG while Samsung model ETA3U30EBE showed magnetic field value of 218 mG. Figure-5 data were taken from Table-7 with magnetic field maximum values in mG.



Table-7. Threshold distances for electric and magnetic fields and magnetic fields radiated from cell phone chargers in Dhaka.

Charger name	Model	Input V	Output V	Magnetic field (mG)
Xiaomi	MDY-08-EF	100-240V 0.20 A	5V – 2A	233
Nokia	AC50E	100-240 V 0.20A	5V -1.3 A	12
Samsung 1	EIAOU10EWE	100-240 V 0.15A	5 V – 0.7 A	32
HTC	TCU250	100-240 V 0.20A	5 V - 1A	16
Samsung 2	ETA3U30EBE	100-240 V 0.15A	5 V - 0.7A	218
ASUS	PSM06K-050Q	100-240 V 0.25 A	5.2 V – 1.35 A	175
Oppo	S11C20	100 – 240 V 0.45 A	5V – 2.1 A	76
Huawei	HW-050100E01	100-240 V 0.20A	5V – 1 A	43

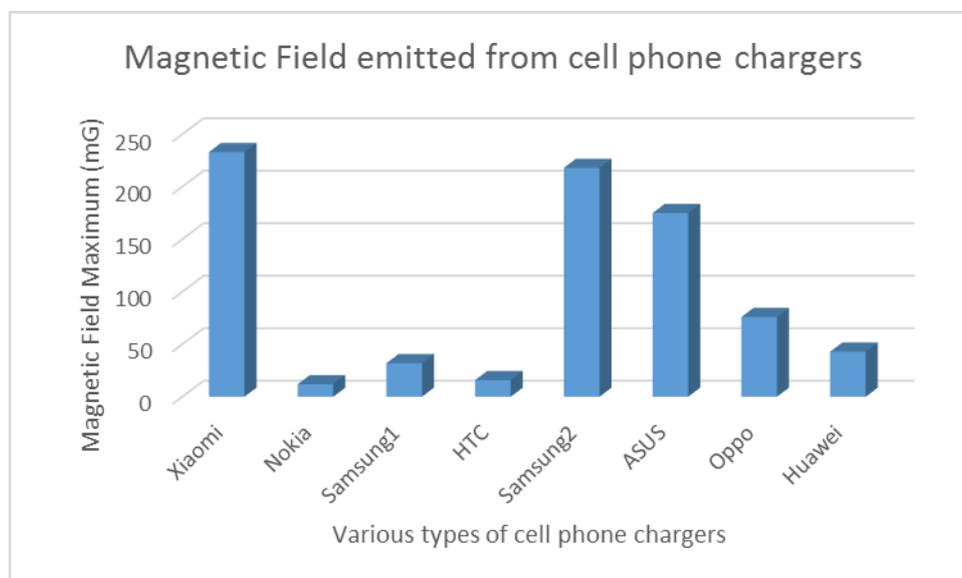


Figure-5. Graphical representation of magnetic field maximum values (mG) from Table-7.

DISCUSSIONS

It was found from the results that the magnetic fields are considerably higher than the threshold limit. Due to the type of wiring in the ceiling and floor, all the rooms had a higher magnetic field than the threshold value. Most of the places in residential locations are occupied by members of the family including children and they get exposed to the above threshold level magnetic fields. We have in mind to include other places of Bangladesh for the study to continue.

Possible risk to health can be produced either as a consequence of the contact of the human body to NIR or by interaction with technical devices, which are themselves influenced by NIR, increasing health hazards (interference with electro medical machines, accidental activation of electrical detonator and explosion of combustible ingredients). This is of concern if the persons

involved are not conscious of the possible risk to be incapable of identifying it.

CONCLUSIONS

From the above results, it has been achieved that in many cases the magnetic field has crossed a threshold value. The electric field also has a higher threshold value in some of the equipment. Also, the magnetic field maximum exposure was over 200 mG in many cases. Proper wiring should be carried out corresponding to the building code 2012. It is hoped that this survey will be helpful as a preventive measure for all of the people residing in Dhaka so that more protective measures are taken for future dwellings.



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