Research Journal of Engineering Sciences ISSN 2278 – 9472
Vol. **3(6),** 38-45, June **(2014)** *Res. J. Engineering Sci.*

Electromagnetic Radiations: An Invisible Poison

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Available online at: www.isca.in, www.isca.me
Received 21st May 2014, revised 9th June 2014, accepted 25th June 2014

Abstract

As the use of these electrical and electronic products is increasing exponentially across the globe, there is a high concern over public health because of the radiations emitted by them. A random survey was conducted on 403 people across the country. The aim of survey was to examine the health conditions of people using various electronic and electrical products if they face any health issues due to usage of these products. During survey it was observed that headache is the most common symptom observed by majority of people, followed by irritation in eyes, stress, pain in ears due to prolonged usage of cell phones, etc. Only 12% people are fairly aware about radiations and its ill effects on health. So awareness must be spread amongst masses. Indian government revised radiation density norms in 2013 and adopted 1/10th of the international norms specified by International Commission on Non- Ionizing Radiation Protection (ICNIRP). Study of Chandigarh was also conducted to check if these changes have been implemented and comparison of readings was done with the biological limits over which health of living beings starts getting influenced. It was observed that observed readings are considerably low than the international norms and limits adopted in India but are several times higher than the biological limits. More strict norms should be adopted and radiation density should be reduced without compromising with the quality of service.

Keywords: Electromagnetic radiations, radiation density, health effects, cell towers, survey.

Introduction

Electromagnetic radiations consist of electric as well as magnetic waves that propagate through space at the speed of light[1]. Electromagnetic field or radiations are present almost everywhere in this world. We are exposed to both man made as well as natural radiations[2].

Table-1
Sources of radiations[3]

Sources of Radiation	Examples
Natural	Sun, electrical discharges in atmosphere of earth etc.
Man-made (Artificial)	Mobile Phone, laptop, computer, tab, microwave oven, compact fluorescent lamps (CFL), electric heaters, toasters, cell towers, television, medical devices, etc.

Electromagnetic radiations are classified into two categories: Ionizing and Non- Ionizing[1]. Ionizing radiations have the potential to remove electrons from an atom as they possess sufficient energy. Examples of ionizing radiations are X-rays and gamma rays and they can present a health risk when their energy is absorbed by the tissue as it can damage DNA. Both radio waves and microwaves come in the category of non-ionizing radiations and they don't have sufficient energy to break the chemical bonds in molecule[2]. Earlier it was believed that low frequency fields do not have any health effects as they are too weak to cause heating but now there exist many studies that say these weaker non- thermal fields also has biological effects[4].

The effects caused by radiations can be of two types- thermal and non-thermal. Thermal effects are observed when temperature is greater than absolute zero. Sunlight is an example of thermal effects and it is emitted by hot plasma of the sun. When phone is kept near ear for a long time then usually warming sensations are observed in ear and this problem has been reported by millions of cell phone users across the globe. This is an example of thermal effect. When no prominent change in temperature is noticed, non-thermal effects are observed[5]. These effects are long term effects and are not observed during initial years. They are observed usually after 8 to 10 years of exposure[6].

Although electromagnetic radiations occur in nature and are present on earth from centuries as sun is a source of electromagnetic radiations but their effects on human health have become more pronounced due to rapid advancement made by human beings in science and technology. Exponential growth in telecom sector has added into this electromagnetic pollution. Thus, human beings are exposed to a complex mixture of many electric and magnetic fields at various different frequencies[4]. There are various studies showing ill effects of radiations on various human beings, environment and animals.

This paper comprises of two main sections. Firstly, a survey on random people was conducted across the country to study if there is any relationship between usage of various electrical and electronic products on people living near and far from cell

towers. Secondly, radiation density of various base stations in Chandigarh was collected and examined. It was compared with the international norms set by ICNIRP and biological limits above which effects are observed on human beings and animals.

Questionnaire: There are various studies which indicate that the use of products such as mobile phones, laptops, microwave oven etc. may lead to symptoms like headache, sleep disorder, impaired concentration, fatigue and even cancer. A questionnaire has been conducted across the country to know views of people on electromagnetic radiations health effects, if they have faced any health issues and how much they are aware about these radiations. The questionnaire was designed specifically for this study and it contains questions on health condition and complaints of people due to the usage of electronic and electric products as well as frequency of usage of these products. 200 copies were distributed among random people of Delhi and Chandigarh, with different age groups and occupation, out of those 180 (90%) were completed. An online survey was also launched on google docs to get the responses from people all over the country and it was filled by 223 people.

People were ensured that there information would be kept confidential and this survey is being conducted to know which electrical and electronic products they use and if they have faced any adverse health effects due to the usage of these products as these products emit electromagnetic radiations. A total of 403 random people of different age groups ranging from 16 to 72 and occupation participated in this survey. 60.4% male and 39.6% female participants were there who filled this survey. 43% students were in majority who participated in this survey. Second to them were 23% IT professionals. Rest were people who were government employees (12%), businessman (9%) and others were housewives, air hostess, food technologists etc. (12% total). 74% people were of age between 20-30 years. 62% people take sleep between 6-8 hours which is good for health. 50 people, i.e., 12.5% people were suffering from problems like cervical, migraine, thyroid, etc. Rest 87.5 % reported themselves to be in fairly good condition. Eventually, 353 questionnaires were subjected to analysis, excluding the data from respondents who reported health problems like migraine, sinus, cervical, etc. as these people were already having such problems. Amongst electronic and electrical products used by people, mobile phones are the favorite (95.3%), followed by tube light (83.3%) and laptop (77.4%). Television, compact fluorescent lamps (CFL), computer, microwave oven, tab are used by 72.9%, 53.6%, 46.2%, 30.8%, 13.4% people respectively. 48.4% people use these products for 5-10 hours a day, 22.8% for 10-15 hours and 2-5 hours, 7.4% for 15-20 hours and 2.4% for above 20 hours. 58.3% people noticed unusual health symptoms due to the usage of these products, while 27.2% didn't find any change in their health and 14.3% were not sure about it. Among symptoms, headache was common, witnessed by 55.2% people followed by irritation in eyes (41.6%), stress (32.8%), sleep disorder (28%), fatigue by 15.7% people. Pain in ears after prolonged use of cell phones was reported by 30% people. This problem is termed as ringxiety or tinnitus and is nowadays reported by millions of cell phone users across the globe[7]. Other symptoms noticed were dizziness, weakness, respiratory problems, skin problems. 12% people declared that they don't have any awareness on this topic while 30% people said that they have read a lot about this issue. 58% declared that they have a little knowledge regarding radiations and its effects. When asked what all they know about it, then majority of them replied that mobile phones should be used less. They were unaware about other electronic devices such as laptop, computer, microwave oven etc. which are also a major cause of health issues.

Duration of usage of electrical and electronic products by people and if they have faced any health issues due to these products.

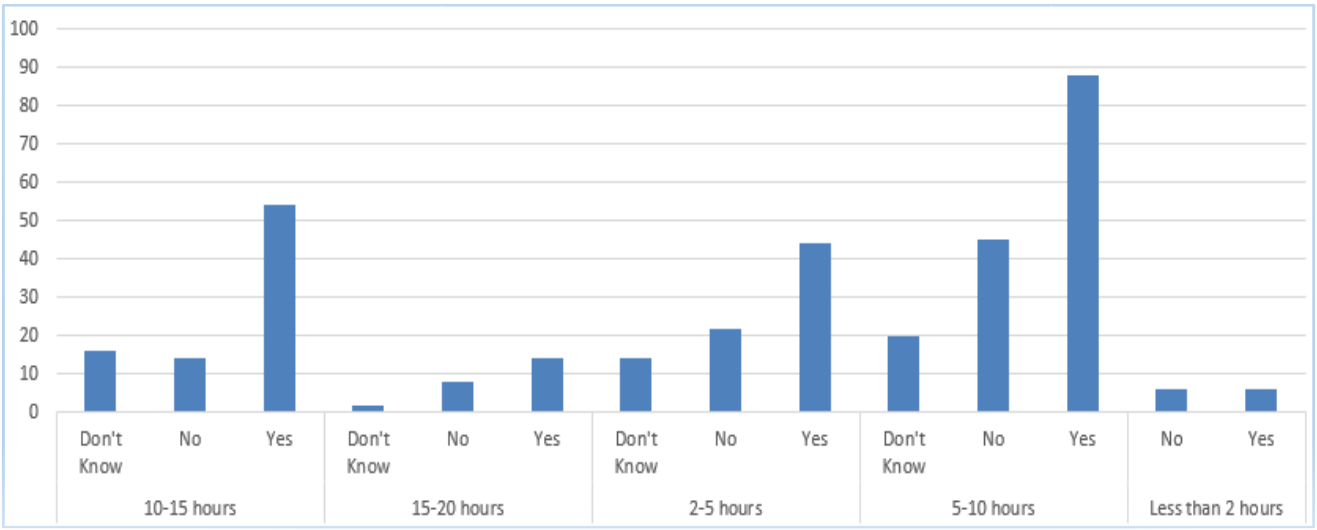

Figure-1
Count of people vs. duration of usage of electronic products and if health issues faced

People reported multiple problems are faced by them like headache, sleep disorder, stress, etc.

Less than 2 hours usage: 6 People using electrical and electronic products like mobile phone, laptop, computer, microwave, tab, etc. for less than 2 hours a day reported no health issues while 6 said that they faced issues like headache, sleep disorder.

2-5 hours: 44 people using these products for 2-5 hours said that they face unusual health symptoms like headache, sleep disorder, stress, and irritation in eyes, 22 declared no health issues and 14 are not sure about it.

Graphical representation of problems faced by people using products from 2-5 hours a day has been depicted in figure 3.

5-10 hours: 88 people who are using these products for 5-10 hours on daily basis reported unusual health symptoms are faced by them, 45 said that they do not feel anything odd after using these products for 5-10 hours daily while 20 were not sure about it. People who are not sure face regular headaches but they say that they can't relate it to these products. Here irritation in eyes along with headache are commonly reported by majority of people. Stress and pain in ears after prolonged use of cell phone is another commonly encountered problems.

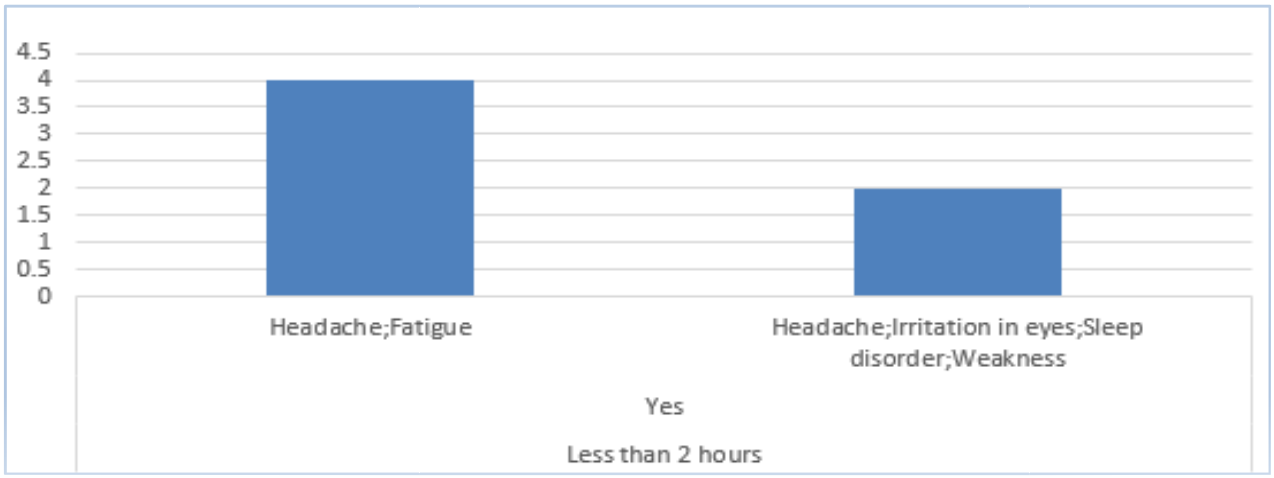

Figure-2
Count of people vs. health issues faced by less than 2 hours of daily usage

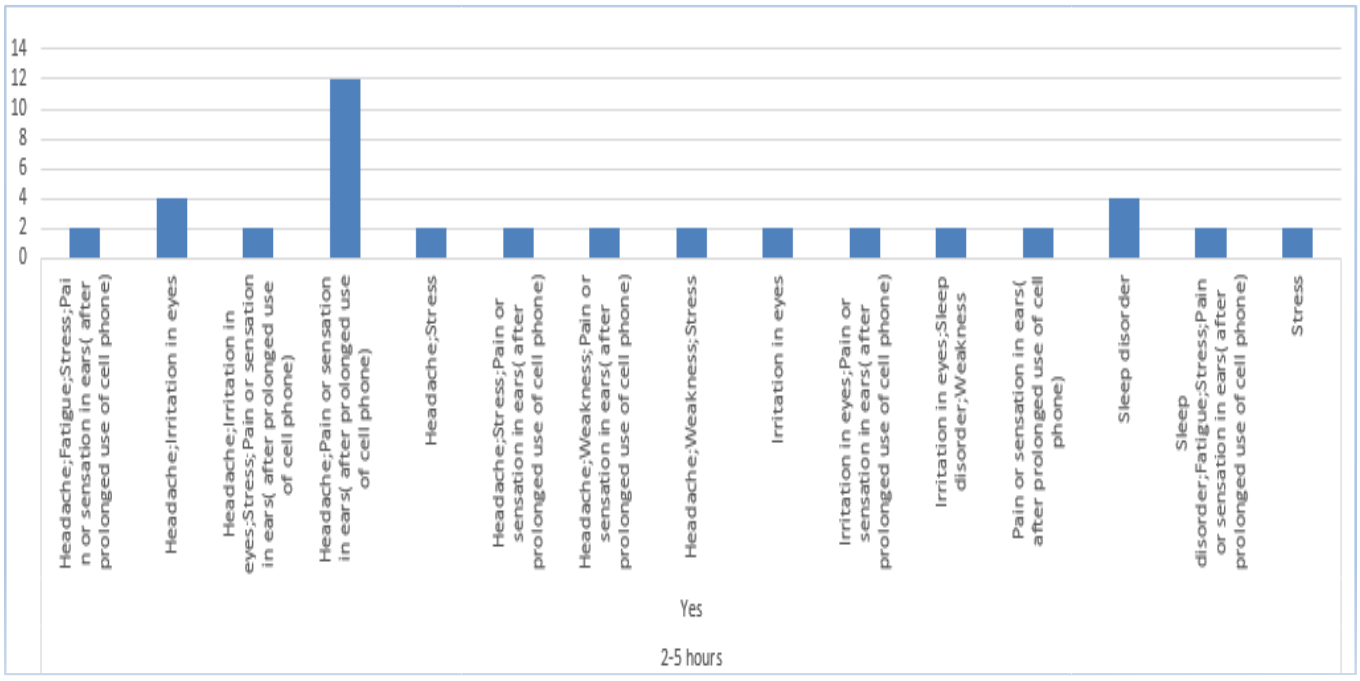

Figure-3
Count of people vs. health issues faced due to 2-5 hours of daily usage

10-15 hours: 84 people said that they use these products for 10-15 hours a day. Out of them 54 reported that they have faced multiple health issues like headache, stress, irritation in eyes, etc. 14 people declared that they don't face any unusual health issues, and 16 people said that they are not sure about it.

15-20 hours: 24 people reported that their usage duration is between 15-20 hours. Out of them 2 are not sure about unusual symptoms but they all have said that they feel irritation in eyes while using these products. 14 reported multiple problems are faced by them while 8 declared that they don't face any health issues.

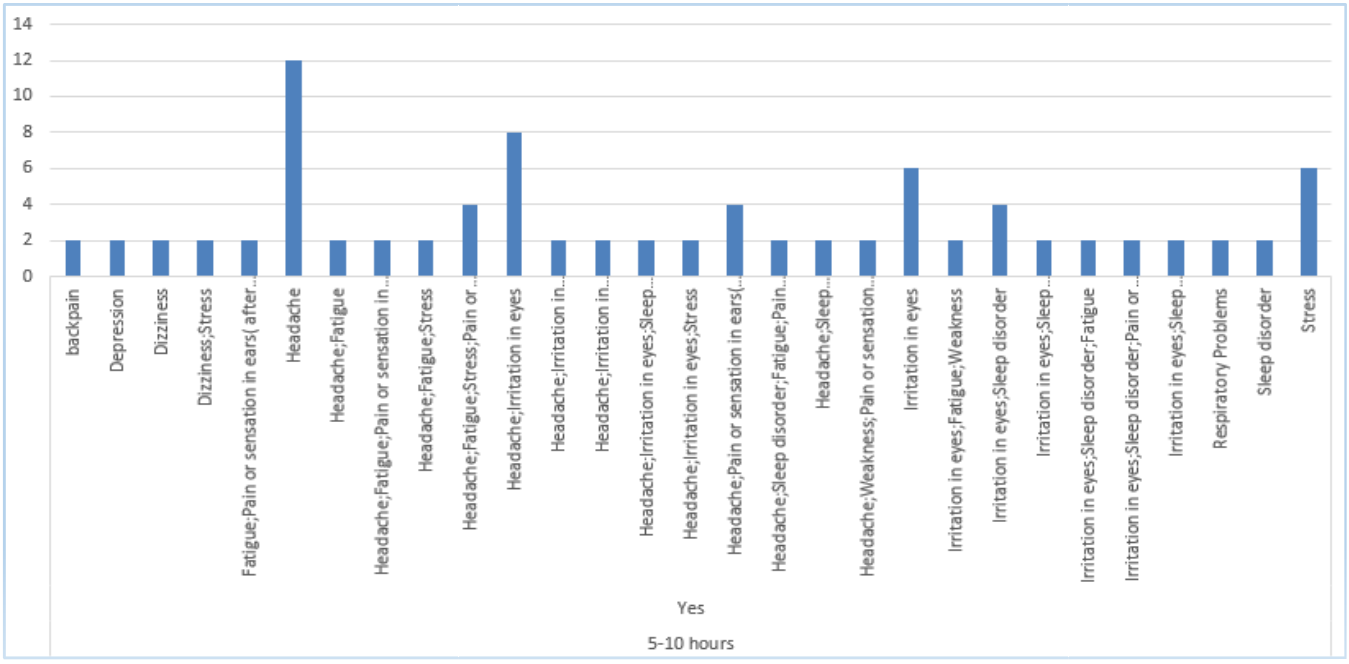

Figure-4
Count of people vs. health issues faced due to 5-10 hours of daily usage

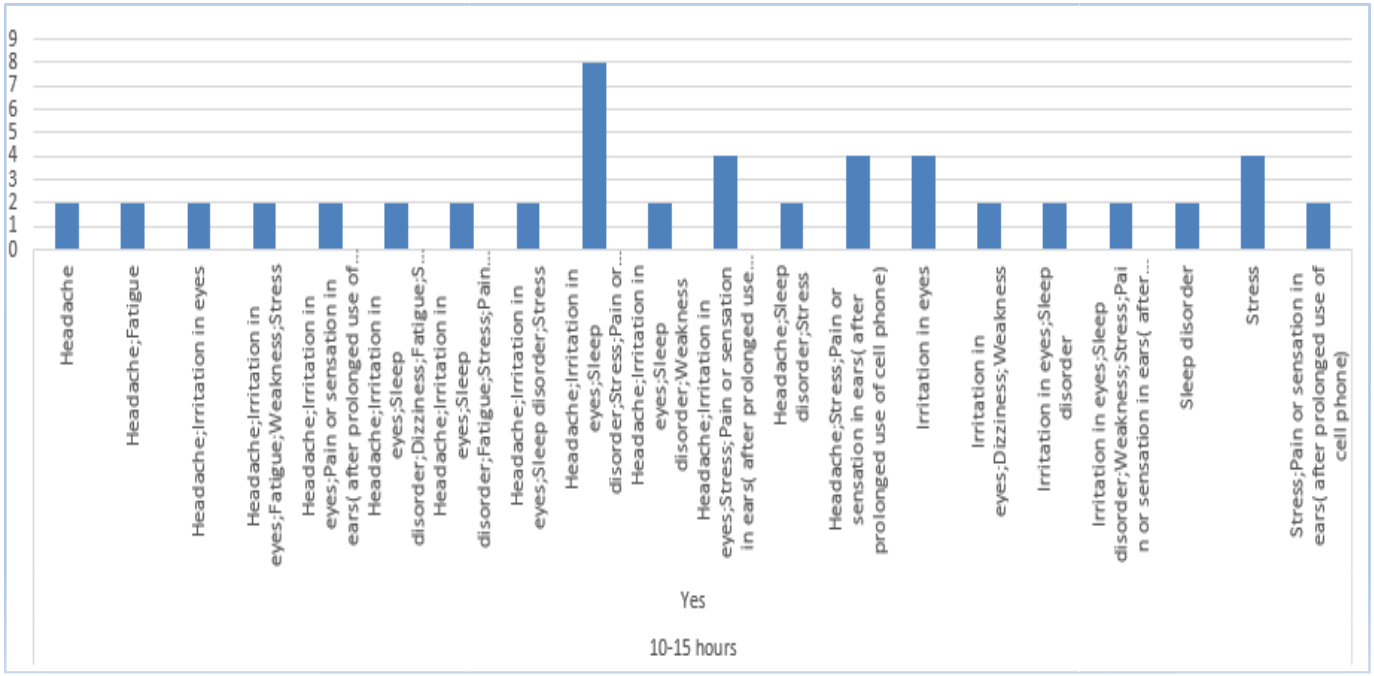

Figure-5
Count of people vs. health issues faced due to 10-15 hours of daily usage

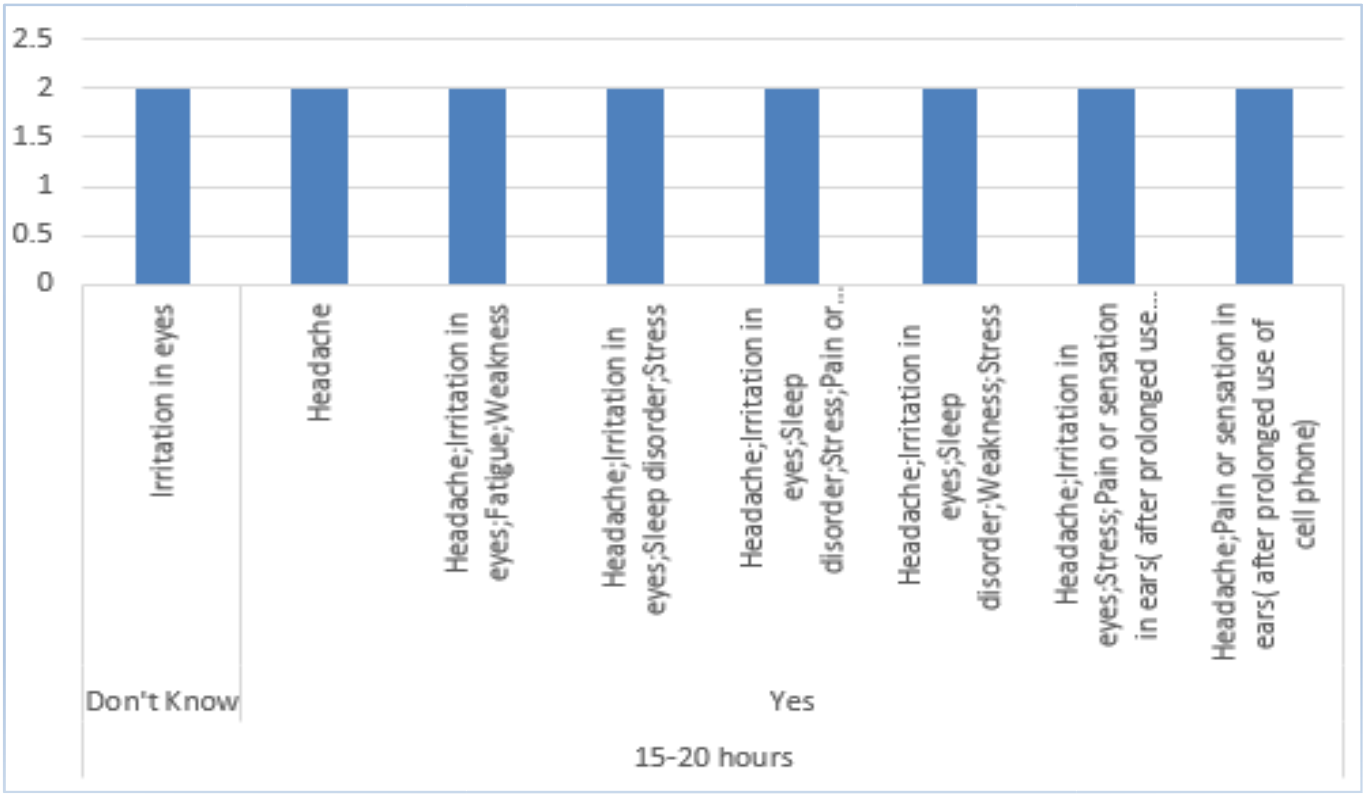

Figure-6
Count of people vs. health issues faced due to 15-20 hours of daily usage

More than 20 hours: Nobody choose this option.

Study of Chandigarh: The survey conducted depicted the health issues faced by people due to the usage of various electronic and electrical products. Along with these devices cell towers also emit electromagnetic radiations and only a few people are aware about it. Radiations emitted by cell towers is a worldwide concern due to its undesirable effects on human beings, animals and vegetation. So, a study across city Chandigarh is done to determine the radiation level across various places in the city. Places such as schools, colleges, markets, hotels, public places and residential areas are covered.

Material and Methods

The spectrum analyzer used to find radiation density is NARDA Selective Radiation Meter (SRM)-3006. This is a portable device and can present excellent immunity for operation in high field strengths. It can provide electric field strength, magnetic field strength as well as power density or radiation density[8].

One observation that was made during this study is that reading of the same place resulted in two different values when it was observed on two different days. This is due to the fact that in practical case, radiations are obstructed by cement walls, metal objects, and many other factors. Radiation level would be more in the location which would be facing the tower than the location which would be on the backside of it. So, it can be said that these readings are not constant and can vary with respect to various factors.

In general, the radiation exposure is determined by following parameters[9]: i. Distance to the place where antenna is located, ii. Line of sight to the antenna site, iii. Type of the antennas, iv. Number of antennas, power, and orientation of the antennas, v. Capacity of the antenna site, vi. Vertical distance between antenna site and location, vii. Type of construction of building, viii. Type of window glass, ix. Total reflection of the environment.

In this study most of the readings were taken between 12pm to 5pm. A total of 65 readings were undertaken at different parts of the city covering different schools, colleges, markets, religious places, other public places and residential areas.

The readings are divided based on the categories such as schools/colleges, market places, residential areas etc. and are represented below in the same manner. The frequency range was chosen from 400 MHz to 3000 MHz.

Graphical Representation of observed radiation density of various places: Considering as a whole, we got minimum power density of 0.002678 mW/m^2 in a residential area while maximum power density was observed as 3.264 mW/m^2 in a market.

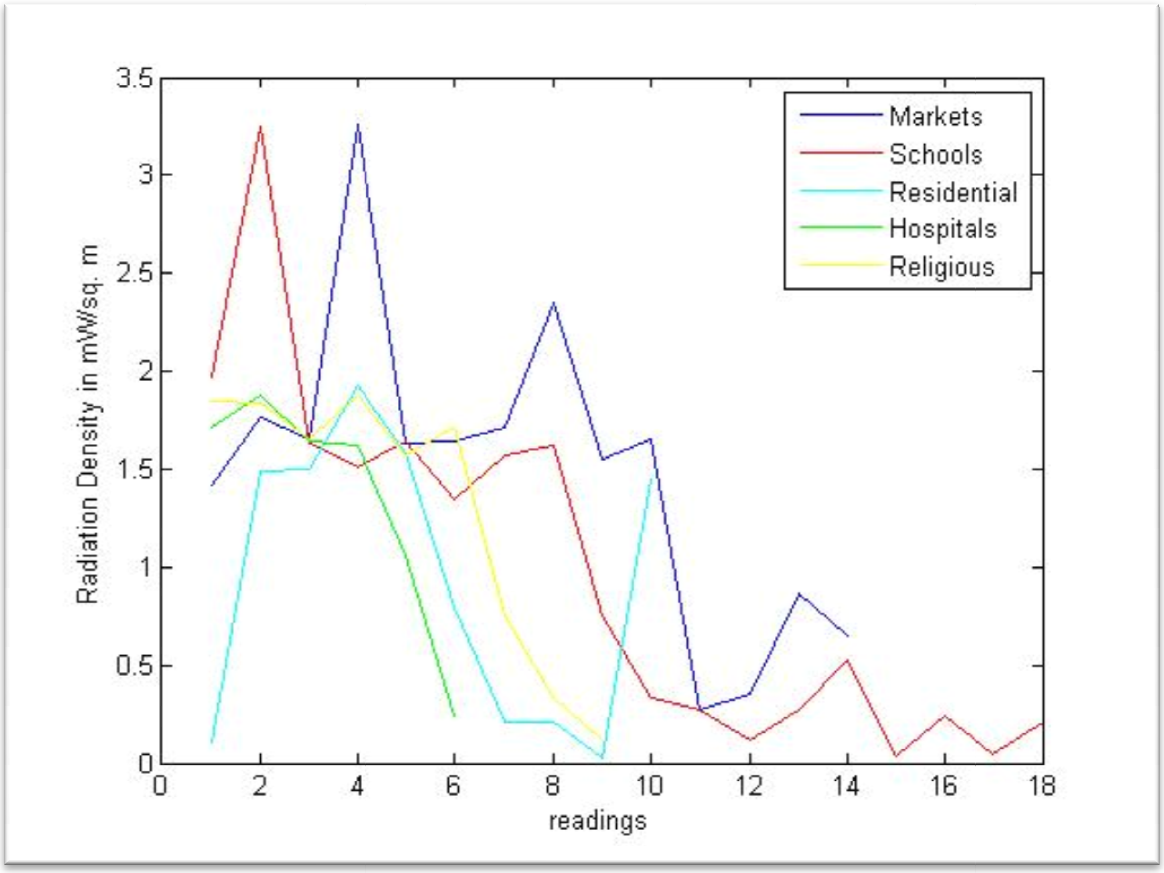

Figure-7
Measured radiation density in mW/m^2

Power Density Limits adopted by India: Norms in India has been revised, which came in effect from August 2013. India has adopted strict limits for radiation from base transceiver station, which is 1/10thof the norms prescribed by International Commission on Non- Ionizing Radiation Protection (ICNIRP)[10].

Table-2
Power density limits in India

Frequency in MHz	Power density limit (mW/m^2)
900	450
1800	900
2100 and above	1000

Comparison between power density limit adopted by India and observed readings of Chandigarh: On comparing readings obtained with the power density limits adopted by India we found that obtained readings are of several order less than the adopted limit of India and international norms.

Effects of radiations at different power densities stated by Bio-Initiative Report 2012: Upon observing all these graphs and power density readings, it can be said that radiations by base transceiver stations (BTS) are considerably low than the radiation density limit imposed by Department of Telecommunications (DOT), India. But these readings are by many orders higher than the biologically safe exposure limits. Bio-Initiative report 2012 presents the detailed analysis of bio-effects, adverse health effects and public health conclusions about impacts of non- ionizingradiation. This report has been prepared by international scientists with reliable tools and approach. Along with that many scientists are working in this field and they have also proposedlimits that are far below the limits set by international authorities like ICNIRP and the limit adopted by India which is 1/10th of the ICNIRP limit. Below represented table indicates some biological effects of radio waves at different power density values[11, 12].

Observations by comparing measured readings with biological limits: As we can observe from the data Table-2 and figure-7 that the measured power density readings are far below the limit adopted by India. But it can be inferred from Table-3 that these radiations are several times higher than the biological safety radiation density limits and can cause adverse effects on health. Around 100 random people concerned with the areas where readings were undertaken were interviewed regarding quality of

service provided. Mostly are satisfied with the telecom services though there are some network issues like call drop or signal related problem. Despite of very low power density, telecom operators are managing to provide fair quality of service. After knowing the adverse effects of radiations people won't mind this little inconvenience as health is far more important than signal strength.

Results and Discussion

Based on questionnaire people are facing health issues by the use of electronic and electrical products. Headache is the most common symptom reported by 55.2% people followed by irritation in eyes (41.6%), stress (32.8%), sleep disorder (28%), fatigue by 15.7% people. Pain in ears after prolonged use of cell phones was reported by 30% people. 12% people declared that they don't have any awareness on this topic while 30% people said that they have read a lot about this issue. 58% declared that they have a little knowledge regarding radiations and its effects. Power density readings were calculated for Chandigarh city and it was found that observed readings are several times lower in magnitude than the international norms set by ICNIRP and limits set by India but they are considerable higher than the biological limits and are capable of causing ill effects to health of humans and animals. So government should come up with more strict limits without much compromising with the service quality.

Conclusion

It has been observed that the measured power density readings for city Chandigarh are far less than the limits prescribed by ICNIRP and limits set by Department of Telecommunications, India. But these values are reasonably higher than the safety limits mentioned by Bio-Initiative report. Through the questionnaire it can be concluded that several people are facing health issues due to usage of various electrical and electronic products and a major section is still not aware about the adverse health effects caused by electromagnetic radiations. So, public seminars should be conducted and awareness must be created amongst masses so that they can save themselves from radiations. Government should conduct regular checks on telecom operators and ensure that operators do not increase the radiation density during peak hours. Self-certification should be discouraged on immediate basis. Study of other cities should be done to keep a check on the radiation emitted by these cell towers. Since telecom operators are radiating 0.1% to 1%of the maximum allowable radiation density and even then a fair service quality is maintained, so it can be inferred that radiation norms can be further strengthen i.e. limits set by the government can be reduced further so as to reduce the harms of radiations. Researchers and scientists are working in this field to come up with the solution that devices should emit less radiations without compromising with their quality of service. Till then precautions should be adopted by people and use of electrical and electronic products should be done wisely.

Table-3
Reported Biological effects observed on different power density values

Radiation Density (mW/m^2)	Biological Effects
0.001	Change in genes, problems with chromatin condensation intensities comparable to base stations
0.0034	Sperm count reduction has been observed with chronic exposure to mobile phone pulsed radio frequency.
0.006-0.128	Tendency to go in depression, tiredness, sleeping disorder, difficult to build concentration, and cardio- vascular problems at base station level exposure reported with exposure to GSM 900/1800 MHz cell phone signal
0.02	Problems like sleep disorder, variation in blood pressure level, tiredness, pain in limbs and joints, nervousness, problems with digestive system
0.03-0.2	N children and teenagers (between 8 to 17 years), short term exposure caused headache, difficulty in concentration, irritation
0.1-0.5	Adults (between 18 to 91 years), headache, neurological problems, sleep disorder was noticed due to short term exposure to radiations of GSM cell phone
0.6	Effects like altered electroencephalography, agitated carbohydrate metabolism, altered adrenal hormone levels, changes in structure of liver, testes, spleen
1	Increase in melatonin level in cows is observed.
1.3	Decreased human epithelial amnion cellsgrowth
1.68	Permanent infertility in mice
2-8	Around transmitters childhood leukemia was observed
3.0	Effects like abnormal time taken to react,afflicted motor function, memory and attention of school kids
6.0	Abnormal rate of muscle contraction in heart, sometimes cardiac arrest in frogs.
10	Commonly observed effects are giddiness, peevishness tiredness, weakness, problem with breathing, pain in head, chest
20	Unusual Sounds like microwave hearing, buzzing. chirping
25	Breakdown of blood brain barrier
0-40	Changed white blood cell activity in school kids

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