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Effects of Mobile Phone and Base Station Radiations on Living Being

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A B S T R A C T

Due to increase in telecommunication facilities, Ujjain, simple and holy city is crowded by number of Mobile Base Stations. Also mobile phone users are also increasing day by day due to its excessive use and dependence. The aim of the present study is to investigate the association of use of mobile phones and radio frequency exposure to base stations with fatigue, headache, dizziness, tension and sleep disturbance etc. in adolescents and adults population of Ujjain and to provide an outcome which can deal with health and social awareness. A survey was conducted among 100 teenager students of age 14-19 years and 100 middle aged people aged 30-45 years of few schools and offices of Ujjain, India. A questionnaire was developed and the primary data in the form of Yes / No was collected and studied. The study showed increased association of fatigue, sleep disturbance, dizziness, loss of mental attention, memory loss, headache, earache, tachycardia, poor eye sight and anxiety while diarrhea and constipation were associated with less frequency as per the interview of the subjects. Also environmental effects were associated in the form of bacterial burden and effect on plant population responsible for ecological imbalance. People living or stay over a long time near mobile based station to ascertain level radiation and make effort to screen the radiation if perceived danger, also individual should reduce their level of making or receiving call with their mobile to avoid some of the potential hazard mentioned conversation with text messages could be a better option. In general, it's our duty to keep the mobile phones as far as possible from our body during our daily life.

Introduction

Worldwide, mobile phone and base station radiation have effect on the health of human being, is a matter of interest and research due to enormous usage of mobile phones throughout the world therefore it makes a global burden on the population. Electromagnetic radiations are used in mobile phones, found in the microwave range i.e. 450–2100 MHz, also other digital wireless systems, for example data communication networks, produce similar type of radiation. Mobile phone use becomes a status symbol as well as a necessity because it serve as a mean of an indispensible communication commonly used by most of the people, due to countless perks provided by the phones.

Worldwide mobile phone subscription has reached from 12.4 millions connections to over 5.6 billions, involving 70% of the global population in the last 20 years (World Health Organization, 2011).

The mobile phones transmit and receive microwave radiations at frequencies of about 900 MHz and 1,800 MHz respectively and these frequencies excite rotation of water molecules and some organic molecules. (Szentpali, 1999) There are two main and direct ways of exposure to radio frequency radiations such as thermal effects caused by holding mobile phones close to the body and possible non-thermal effects, can affect health. Teenagers have more detrimental effect due to cell phone radiation as they absorb more energy due to their smaller size of head and brain, cranial bones and skin are thin, elasticity and more younger cells in the ear, low blood volume of blood and more younger cells in blood and more fast conduction of nerve leads to more penetration of energy than adults from the same device. Adverse health conditions caused by electromagnetic field (EMF) radiations are headache, sleep disorders, lack of concentration, impairment of memory, dizziness, high blood pressure, increased frequency of seizures in epileptic children, and brain tumor etc. (Michael *et al.,* 2000)

Materials and Methods

Sources of Data collection

Data collected from teenagers aged 14-19 and middle aged population of age 30-45 years of Ujjain, study was conducted at selected schools and houses / work places situated within 350 meter radius from base stations in Ujjain.

Population

Teenager students of selected schools using mobile phones and / or living within the radius of 350 meter from base stations and young adults living within a radius of 350 meter from base stations and / or using mobile phones in Ujjain was the population for study.

Sample

Teenager Students attended selected schools and / or lived nearer to base stations and middle aged people lived nearer to base stations and / or using mobile phones was the samples for study. A survey was conducted among 100 teenager students of age 14-19 years and 100 middle aged people aged 30-45 years of few schools and offices in Ujjain, India. Simple randomized sampling was used to select Teenagers and middle aged people in Ujjain.

Inclusion criteria

Available at the time of data collection.
Willing to participate in the study.
Can read, write and speak English.

Exclusion criteria

Cognitive or hearing problems

A descriptive survey design was used to extract answers to the questionnaires administrated to middle aged people and teenager students who were studied in selected schools with prior approval of the Principle and their teachers in Ujjain city, Madhya Pradesh, a state in India.

Characteristic profile (Age, educational status, area and family income) and health risks associated with mobile phone usage and living near vicinities of mobile base stations was the two main criteria on which study of mobile phone usage among the teenagers and middle aged people was conducted. A total of 100 teenagers and 100 middle aged people were selected for the survey.

General questions pertained to estimated distance from base stations (less than 10 m, 10 to 50 m, 50 to 100 m, 100 to 200 m, 200 to 300 m, more than 300 m) and their location in

relation to the antennas (facing, beside, behind, beneath in the case of antennas placed on rooftops).

Perception questionnaire on mobile phone and base station radiation hazard studies

Name:

Students ID (for Students):

Genders: Male / Female

Ages:

Date of birth:

Courses (for Students):

Do you use a cell phone: Yes / No

How long have you been using a cell phone (MM/YY):__/__

How many cell phones you use currently:

Cell phone(s) brand that you're using:

Where do you carry your cell phone: pouch / pocket / around your neck / in the bag / any other

Are you living near to a Mobile Base Station: Yes / No

If yes, how far is it from your home/school/work place?

<10 meters
10-50 meters
50-100 meters
100-200 meters
200-300meters
>350 meters

Average no. of calls received/dialed daily:

The average duration you talk (both incoming and outgoing) on the phone daily (in minutes):

Which ear that you normally use when you're on the phone: right / left / both / not sure

Average no. of SMS received/sent daily:

Are you using any cell phone accessory(s): Bluetooth: yes / no Hands free: yes / no

Do you use cell phone while driving: Yes / No

Each call in minutes received/called for 3 consecutive days:

Do you think the following health hazards are associated to cell phone usage?

Are you aware of the several unwanted effects of using the cell phone: Yes / No

How do you think you can minimize the unwanted effects?

Decrease the talking duration: Yes / No
Increase the length of hands free: Yes / No

Any other method(s): _____

Do you actually practice any of these measures: Yes / No
If no, why?

Results and Discussion

There are several studies that is related with the damage to the body such as memory confusion and memory lapses, headaches and whizzing sounds in the ear, cause headaches and induce extreme fatigue, create joint pain, muscle spasms and tremors, create burning sensation and rash on the skin, alter the brain's electrical activity during sleep, induce ringing in the ears etc. (Khan *et al.*, 2008). A study conducted by Santini *et al.*, (2003) in France

on a variety of self-reported symptoms for people who reported that they were living at a distance of less than 300 meters in rural area while in urban area within 100 meters from mobile base stations having the symptoms of fatigue, sleep disturbance, headache and loss of memory etc. Fatigue, irritability, headache, nausea, appetite loss, discomfort, gait difficulty was reported by Enrique *et al.,* (2003), headaches, exhaustion tiredness, difficulties to concentrate, feeling strained, urge for sleep were observed by Hutter *et al.,* (2006), Higher concentrations of alpha-amylase in their saliva, obsessive-compulsive, anxiety was observed by Viel *et al.,* (2009), while headache, skin irritation, anxiety, sleep disorder, weight loss was seen by Akintonwa *et al.,* (2009) which were correlated with our study as it showed the similar level of discomfort in our target population.

This is a real environmental concern in many developing countries, since the non-discriminatory manner in which these base stations are sited in close proximity to residential homes, offices, hospitals and schools increases the exposure level in such environment as shown in the study done by Otitoloju *et al.,* (2010), indicates that the mobile base station should not be in close proximity to residential area. These surveys are not of so much importance as they are not having statistically significant data which include most of the representative part of the population and those people which are less in number, having complaint of severe adverse effect are to be cautious and must take appropriate precaution regarding radiation. Conducting studies on populations living near to base stations, for the assessment of radiation exposure individually would be a big task.

An additional reason is the use of mobile phones during the school hours, as in the result outcome of a study, 36.1% students use the mobile phone in the School premises and 51% said that their teacher are familiar with their mobile usage in the schools. In the United States, the majority of public schools have a rule against the use of cell phones in school, which requires students to either leave their phones at home or keep them in the switched off mode during the school hours in a study done by Obringer and Coffey (2007). Other schools have started a policy where students are allowed to use cell phones either before or after the school hours only and not within school hours in a study shown by Gerard (2006). Conversely, parents feel that if the child have mobile phone it improve their safety and protection as their location can be assessed and can remain in constant touch with their child and maintain a record of their children school activities or even contact them if any emergency arises as said by Obringer and Coffey in 2007 and Zirkel shown in a study done in 2008 (Gerard, 2006; Zirkel, 2008). In our survey, we found that students were not exactly aware about the ecosystem disturbance by the use of mobile phones which is quite critical. Our system suffers the ill effects of mobile phone radiations as well. The most recent example is the noticeable increased use of these in the population.

Tinnitus, also k/a “Ringxiety”- a psychological disease of having sensation and hearing of cell phone ring in millions of cell phone users in the world, is mainly found in the people who are addict of mobile phones or in new users. These people have severe trouble in hearing, while they are working in a serious task or even when they are sleeping.

Radiation induced irreversible damage to the delicate working of inner ear can occur due to long term and addicted use of mobile phones for a duration of four years or more and in a day of approximately 30 minutes or more carries a higher risk of developing deafness either mild, moderate or severe (Fig. 1 and 2; Table 1–5).

Table.1 Showing the result of interview questionnaire as per the knowledge of the subjects

Tasks	Criteria	Age 14-19 years%	Age 30-45 years%
Are you living near a mobile base station	Yes	28	41
	No	72	59
If yes, how far is it from your home/school/workplace (In Metres)	<100	14	31
	>300	31	30
	100-200	25	23
	200-300	30	16
How much time do you spent near base station vicinity (In Hrs)	<3	62	36
	3-8	13	28
	8-12	10	12
	12-18	13	21
	18-24	2	3
Average number of calls received/dialed daily	<10	81	65
	>10	19	35
Average time duration of daily talk (In Hrs)	<1	99	96
	>1	1	4
Do you think the following health hazards are associated to cell phone usage			
Fatigue	Agree	66	71
	Disagree	34	29
Sleep Disturbance	Agree	87	78
	Disagree	13	22
Dizziness	Agree	64	66
	Disagree	36	34
Loss of Mental attention	Agree	83	81
	Disagree	17	19
Memory Loss	Agree	51	74
	Disagree	49	26
Headache	Agree	80	74
	Disagree	20	26
Earache	Agree	70	72
	Disagree	30	28
Tachycardia	Agree	54	53
	Disagree	46	47
Diarrhea	Agree	16	28
	Disagree	84	72
Constipation	Agree	24	34
	Disagree	76	66
Poor Eye Sight	Agree	75	63
	Disagree	25	37
Anxiety	Agree	75	70
	Disagree	25	30

Table.2 Effect of base station radiations on the number of bacterial and fungal spores

Air sample analysis at 100 meter far from mobile base station	
Sample # 1 - No of bacterial spores	
1 cm^2 = size of filter paper used for plating	
Filter paper suspended in 4 ml sterilized H_2O = 0 dilution	375000 X 4 = 1500000
1+4 ml - 1st dilution	75000 X 5 = 375000
1+4 ml - 2nd dilution	15000 X 5 = 75000
1+4 ml - 3rd dilution	3000 X 5 = 15000
1+4 ml - 4th dilution	600 X 5 = 3000
1+4 ml - 5th dilution	600
Got 12 Colony forming units (CFU) / plate bacterial colonies	
0.1 (5th dilution) = 12/0.1 X 5 = 600 Bacterial spores	
Total Number of Bacterial Spores	15 X 10^5
Sample # 1 - No of fungal spores	
1 cm^2 = size of filter paper used for plating	
Filter paper suspended in 4 ml sterilized H_2O = 0 dilution	
Plated 0.1 ml in Potato Dextrose Agar (PDA)	
Got 2 CFU / Plate fungal colonies	
0.1 (0 dilution) = 2/0.1 X 4 = 80 fungal spores	
Total Number of Fungal Spores	80

Table.3 Air sample analysis at more than 500 meter far from mobile base station	
Sample # 2 - No of bacterial spores	
1 cm^2 = size of filter paper used for plating	
Filter paper suspended in 4 ml sterilized H_2O = 0 dilution	
1+4 ml - 1st dilution	5850 X 4 = 23400
Plated 0.2 ml in nutrient agar	5850
Got 234 Colony forming units (CFU) / plate bacterial colonies	
0.2 (1st dilution) = 234/0.2 X 5 = 5850 Bacterial spores	
Total Number of Bacterial Spores	23400
Sample # 2 - No of fungal spores	
1 cm^2 = size of filter paper used for plating	
Filter paper suspended in 4 ml steralized H_2O = 0 dilution	
Plated 0.2 ml in Potato Dextrose Agar (PDA)	180
Got 9 CFU / Plate fungal colonies	
0.2 (0 dilution) = 9/0.2 X 4 = 180 fungal spores	
Total Number of Fungal Spores	180

Table.4 Audiometry of few of the samples shows that continuous and more use of mobile cause impairment in hearing

S. No.	Left ear		Right ear		Inference
	Frequency (in KHz)	Sound (in dB)	Frequency (in KHz)	Sound (in dB)	
1.	6000	25	6000	25	Bilateral normal hearing
2.	6000	55	6000	60	Bilateral moderate sensori-neural hearing loss
3.	8000	40	6500	65	Bilateral moderate sensori-neural hearing loss in left ear & moderate mixed hearing loss in right ear
4.	6000	15	6000	15	Bilateral normal hearing
5.	6000	40	6000	40	Bilateral mild conductive hearing loss
6.	6000	20	6000	25	Bilateral mild conductive hearing loss
7.	6000	20	6000	25	Bilateral normal hearing
8.	6000	10	6000	15	Bilateral normal hearing
9.	6000	15	6000	20	Bilateral normal hearing
10.	6000	10	6000	20	Bilateral normal hearing
11.	6000	10	6000	20	Bilateral normal hearing

Table.5 Effect of Wi-Fi (Router) Radiations on the growth of seeds of different crops

Effect of Wi-Fi(Router) Radiations on the growth of seeds of different crops						
Distance from Router(in meter)	**MAIZE**					
	No of seeds germinated out of 20 on					
	Day 1		**Day 1**		**Day 1**	
0.5	-	0.5	-	0.5	-	0.5
1	-	1	-	1	-	1
3	-	3	-	3	-	3
Distance from Router (in meter)	**Wheat**					
	No of seeds germinated out of 20 on					
	Day 1		**Day 1**		**Day 1**	
0.5	-	0.5	-	0.5	-	0.5
1	-	1	-	1	-	1
3	-	3	-	3	-	3
Distance from Router (in meter)	**Pearl Millet**					
	No of seeds germinated out of 20 on					
	Day 1		**Day 1**		**Day 1**	
0.5	-	0.5	-	0.5	-	0.5
1	-	1	-	1	-	1
3	-	3	-	3	-	3
Distance from Router (in meter)	**Jowar**					
	No of seeds germinated out of 20 on					
	Day 1		**Day 1**		**Day 1**	
0.5	-	0.5	-	0.5	-	0.5
1	-	1	-	1	-	1
3	-	3	-	3	-	3
After Sowing Germinated Seeds, length of Saplings						

Distance from Router (in meter)	MAIZE					
	Length of Sapling on day (in mm)					
	Day 1		Day 1		Day 1	
0.5	-	0.5	-	0.5	-	0.5
1	-	1	-	1	-	1
3	-	3	-	3	-	3
Distance from Router (in meter)	**Wheat**					
	Length of Sapling on day (in mm)					
	Day 1		**Day 1**		**Day 1**	
0.5	20	0.5	20	0.5	20	0.5
1	2	1	2	1	2	1
3	-	3	-	3	-	3
Distance from Router (in meter)	**Pearl Millet**					
	Length of Sapling on day (in mm)					
	Day 1		**Day 1**		**Day 1**	
0.5	-	0.5	-	0.5	-	0.5
1	-	1	-	1	-	1
3	-	3	-	3	-	3
Distance from Router (in meter)	**Jowar**					
	Length of Sapling on day (in mm)					
	Day 1		**Day 1**		**Day 1**	
0.5	-	0.5	-	0.5	-	0.5
1	-	1	-	1	-	1
3	-	3	-	3	-	3

Do you think the following health hazards are associated to cell phone usage?

Health hazards	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
Fatigue					
Sleep Disturbance					
Dizziness					
Loss of Mental Attention					
Memory Loss					
Headache					
Tachycardia (increased heart rate)					
Diarrhea					
Constipation					
Poor Eye Sight					
Anxiety					

Fig.1 Showing the results of agreement / disagreement regarding fatigue, sleep disturbance, dizziness, loss of mental attention, memory loss and headache

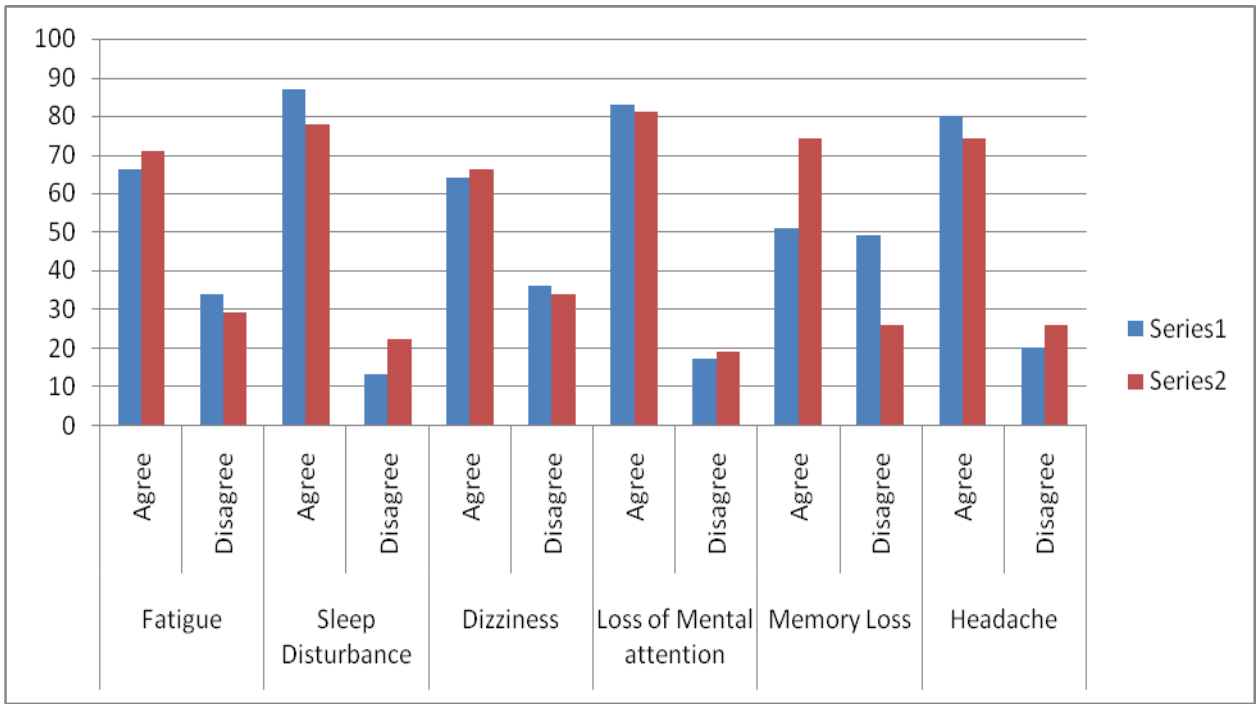
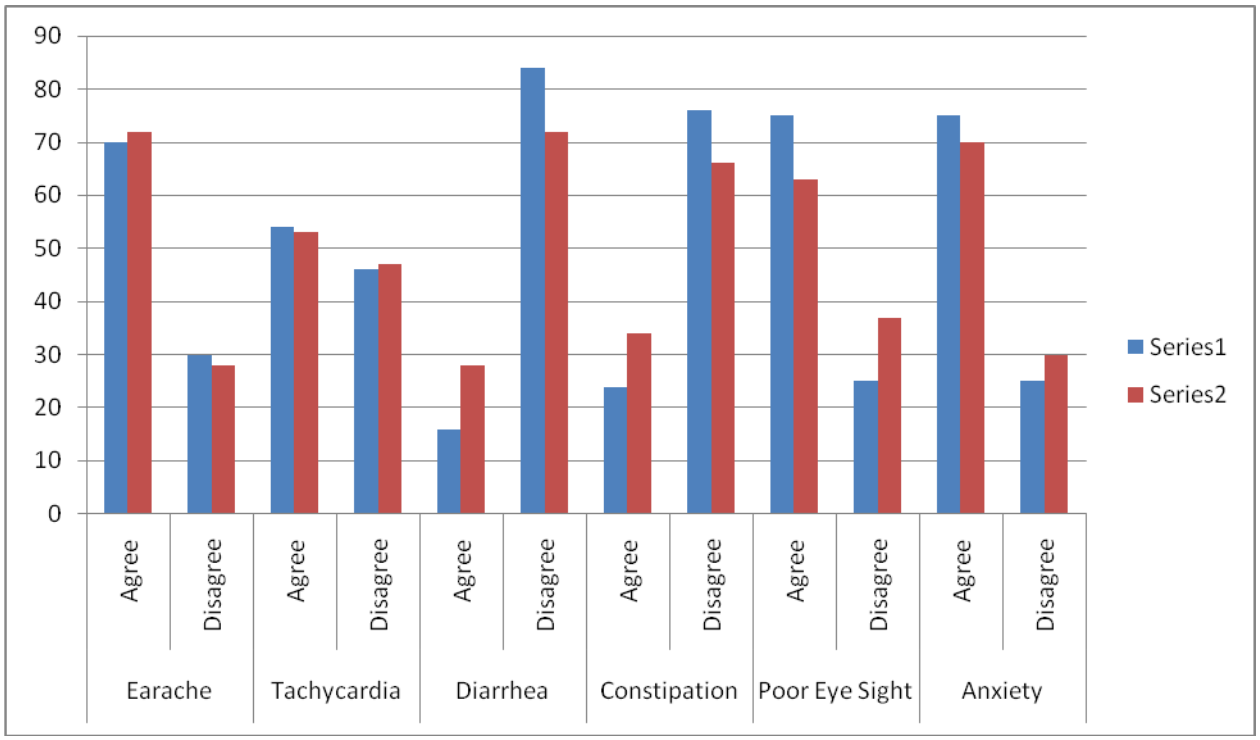


Fig.2 Showing the results of agreement / disagreement regarding earache, tachycardia, diarrhea, constipation, poor eye sight and anxiety



When a person head is illuminated with microwave, auditory perception can occurs as it launches a thermo-elastic wave of acoustic pressure travels through bone conduction in the inner ear, activates cochlear receptors like as the process of normal hearing, explains the "clicks" of microwave radiation, heard by people. Normal hearing depends on healthy 16,000 hair cells in inner ear as their damage leads to permanent hearing loss as these cells can't regenerate in spite that many doctors treat these patients. Now a day young aged persons of age between 18-25 years suffer from hearing loss which can be due to excessive use of mobile phones, high pitch of speaker's etc. Marketing and tele-communication people are having these problems as there works depends on the excessive use of mobile phones, in these persons the affection to inner ear starts with pain in the ear, with time associated with tinnitus or a ringing sensation which finally leads to permanent hearing loss, as minimum duration they spent may be two to three hours or more leads to permanent deafness in three to five years.

In our study environmental effects were associated in the form of bacterial and fungal burden and effect on plant population which is responsible for ecological imbalance as radiation have effect on cellular mitotic as well as meiotic function, having effect on the structure of DNA and its alteration responsible for development of cancers, can affect the food growth as it effect the growth of plant therefore less use of mobile phone lead to less radiation effect, also less number of mobile base stations leads to less exposure to the population and less development of complication.

Proximity with the mobile base stations may result to adverse health effects such as fatigue, sleep disturbances, headaches, feeling of discomfort, and difficulty in concentrating, depression, memory loss, visual disruptions, irritability, hearing disruptions, skin problems, cardiovascular disorders, and dizziness. The level of the symptom depends on: Length of period individuals have stayed or live near the base station; Length of time individual spent on receiving or making calls with his/her mobile phone.

Consequently we recommended that people living or stay over a long time near mobile based station to ascertain level radiation and make effort to screen the radiation if perceived danger, also individual should reduce their level of making or receiving call with their mobile to avoid some of the potential hazard mentioned conversation with text messages could be a better option. In general, it's our duty to keep the mobile phones as far as possible from our body during our daily life.

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