3 Electromagnetic Fields Emitted by Mobile Phone Affects Autonomic Function in Human Being

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ABSTRACT

Introduction: In today's world globalization is the new mantra. It is very difficult not to have technology. But with technology, come certain hazards. The only way to beat these is again, better technology. A cell phone technology is one of them, which introduce in India few years back, but now its need of society. It also works on electromagnetic radiation. The development of wireless communication systems has given rise to concerns about the potential human health hazards of increased and chronic exposure to electromagnetic field (EMF) and radio frequency (RF) radiation. The aim of this study is to find out the electromagnetic field emitted by mobile/cell phone affects autonomic function in human being.

Method: The present study was conducted over a period of three years (2009-2012), which covers urban as well as rural areas of Surat districts. The study includes anthropometric parameters (like Height, Weight, BMI), Clinical examination (like Pulse rate, base-line blood pressure etc.) and in Autonomic function assessment were performed in various groups. Ethical approval and other aspects were taken into consideration. The data obtained was tabulated with respect to various parameters and was statistically treated and analyzed.

Result and conclusion:In our study resting blood pressure i.e. systolic and diastolic blood pressure values were observed to be significantly increased in mobile phone user group as compared to the control group, which may be due to more pronounced vasoconstriction and carotid sinus reflex, this changes do not alter in all the subjects, but we find the values are significantly increased in mobile phone users.

Although radiation exposures due to mobile phones are very low, but once the energy is absorbed by the biological matter can cause severe and long lasting damage to human health. It might take years for the damage to produce noticeable symptoms. According to that we performed the study and we found the changes accordingly. Based on this, we would like to conclude that the persistent & prolonged exposure to electromagnetic radiation emitted by mobile phone is a risk factor.

INTRODUCTION:

In today's world of Globalization, it is very difficult not to have technology, each day new and newer research will develop better and better technologies. In last decade, one of the developing fields is wireless communication technology like cellular phones, wireless internet, etc. More and more these type of communication services are expected to come up and its difficult to reverse this trend. A cell phone technology, which introduce in India last decade, but now its need of society, it works on electromagnetic radiation. Although the radiation due to

this type of services is very low, but once the energy which is radiating from this absorbed by the biological matter, it can cause effect on human health. It might take years for the damage to reproduce noticeable symptoms. We always welcoming the upcoming technologies, but our consent are about health and safety precautions.

To find out the answer of our basic but important question (i.e. “Are mobile phone safe?”) the apparent place to begin with is an internet and we found that, very limited data available on the possible effects. Autonomous scientific studies are showing the risks like increase B.P., brain tumor, infertility problem in male etc. But sponsored studies unsuccessful to show an apparent link between mobile phone uses & health risk. whereas there are no adequate indications that health parameters of rodents is affected by exposure to electromagnetic field, the data are still inconclusive, considering the above fact, we have designed the present detailed and prolonged duration study, to find out electromagnetic fields emitted by mobile phone are affects autonomic function in human being.

A mobile/cell phone is a low-power, single-channel; two-way radio and on the other hand cellular/mobile base stations are low-power multi-channel two-way radios. They produce radio-frequency (RF) energy for the communication purpose (that's how they communicate), and along with communication they expose people near them. This RF energy can also be called microwaves, radio waves, RF radiation (RFR) or RF emissions. Around the world a variety of frequencies are used for mobile/cellular phones [Stuchly, 1998]. And the interaction of that energy with biological material (like cells and its organelles) depends on the source used and its frequency [Foster, 1997], and most common frequencies for mobile/cellular phones are 800-900 MHz.

According to Adair [1994] the RF energy absorbed by humans may be less because the phones are low power and the RF energy emitted from them are generally very low. Although exposures are very low, but once the energy (thermal and non thermal) is absorbed by the biological matter, it can cause long lasting damage to it. It might take years for the damage to produce noticeable symptoms but harmful changes are manifest.

AIMS & OBJECTIVE

To find out the electromagnetic field emitted by mobile/cell phone affects autonomic function in human being.

MATERIALS & METHODS

The present study was conducted over a period of three years (2009-2012). This covers nearby areas of Surat districts which includes its urban and rural areas. The protocol was explained to 108 volunteer subjects, out of which 96 were selected after personal interview. In second year out of that 26 persons drop out so we studied 70 subjects overall, in which Group I consists of 34 subjects called control group and Group II consists of 36 subjects called mobile/cellular phone user group. Ethical approval and other aspects were taken into consideration while planning the experiments and written informed consent was obtained from each of the participant.

SELECTION OF SUBJECTS

Mobile users were specified and selected on the bases of our basic criteria. In that, at the time of first meeting with them we adjusted the new call time by call manager setting and after six days we calculated the average mobile operating time. The persons were identified who had fulfilled our basic criteria, that the user must have been using his phone for 25 hrs/month or more and must have been operating the mobile phone form last one year or more.

METHODOLOGY

The study includes Anthropometric parameters; Clinical examination and Autonomic function assessment were performed in both groups.

- **Anthropometric parameters:**

  This includes height, weight, BMI etc.

- **Clinical examination**:

  This includes Pulse rate and base-line blood pressure etc.

- **Autonomic function tests**

  Tests used to evaluate the **Sympathetic activity** are:

  1. B P response to standing
  2. Blood Pressure response to sustained handgrip

  Tests used to evaluate the **Parasympathetic activity** are:

  1. Heart rate response to standing
  2. Heart rate response to Valsalva maneuver

1. B P Response To Standing

Resting systolic blood pressure was recorded in lying down position and thereafter in standing position after 1 minute. Difference in systolic blood pressure between lying and standing position was recorded [Ewing D. J., 1988].

If systolic pressure decreased by $\leq$ 10 mmHg than it was taken as Normal, borderline if 11 – 20 mmHg and abnormal if $\geq$ 30 mmHg [Ewing D. J., 1988].

2. Blood Pressure Response To Sustained Handgrip

After an initial period of rest, base line blood pressure (mmHg) was recorded. Then each subject was told to perform isometric hand-grip (IHG) exercise with the help of hand grip dynamometer. The pressure on maximum compression by hand grip was recorded after 3 hand-grip exercises. Then the subjects were instructed to sustain the hand grip pressure at 30% of the maximum pressure for 5 min. Blood pressure changes were recorded at the interval of one min during the process. Change in Systolic Blood Pressure (SBP) is the most sensitive & specific measurement in diagnosing abnormality.

If systolic pressure decreased by > 16 mmHg than it was taken as Normal, borderline if 11 - 15 mmHg and abnormal if < 30 mmHg [Ewing D. J., 1988].

3. Heart Rate Response To Standing

ECG limb leads were attached to subject with strip recorder running in lead II, Subject was asked to stand from lying as quickly as possible. Measured 30: 15 ratio i.e. ratio of longest

R-R interval at 30th beat to shortest R-R interval at 15th beats after standing. [Ewing DJ., 1988]. Normal: ≥ 1.04. Borderline: between 1.01-1.04. Abnormal: ≤ 1.00 [Ewing D. J., 1988 and Hutchison's clinical method, 19th ed.1989].

4. Heart Rate Response To Valsalva Maneuver

The nose clip was applied to the subject and asked to blow into the sphygmomanometer to raise the mercury column to 40 mmHg pressure and retain it at that level for 15 sec. The ECG was recorded 15 sec. during manoeuvere & 30 sec. after the manoeuvere. Valsalva ratio was calculated as ratio of maximum heart rate during the strain (during manoeuvere) to the minimum heart rate after the strain.

If valsalva ratio increased ≥ 1.21 than it was taken as Normal; borderline if the value was between 1.11 – 1.20 and abnormal if ≤ 1.11. [Ewing D. J., 1988 and Hutchison's clinical method, 19th ed. page no. 366, 1989].

OBSERVATION & RESULTS

The study group comprised of 70 of apparently healthy subjects. The autonomic function tests were performed in all these subjects after the completion of recording of anthropometric parameter and clinical examination. The data obtained was tabulated with respect to various parameters and was statistically treated and analysed. The data was arranged into suitable tables for discussion under the different headings. The mean difference was taken to be significant at P<0.05 levels. Statistical analysis was done using SPSS software version 17 for windows.

Table 1: Autonomic function assessment: B P response to standing in control group

		Blood Pressure (mm of Hg)		*1 Min. After Standing*	
		Systolic	***Diastolic***	***Systolic***	***Diastolic***
Control Group (N = 34)	***Mean***	116.53	74.65	108.77	84.24
	+SD	13.33	9.01	13.52	8.29
Mobile Users (N = 36)	***Mean***	130.33	82.39	118.17	92.17
	+SD	10.91	8.44	11.54	7.82

Table 2: Autonomic function assessment: Blood Pressure response to sustained handgrip

Group ⇩		**B.P. (mm of Hg) Response to Sustained Handgrip**									
		After 1 Min.		**After 2 Min.**		**After 3 Min.**		**After 4 Min.**		**After 5 Min.**	
		SBP	**DBP**	**SBP**	**DBP**	**SBP**	**DBP**	**SBP**	**DBP**	**SBP**	**DBP**
Control Group (N = 34)	**Mean**	**121.4**	**82.5**	**127.7**	**90.0**	**134.7**	**95.7**	**139.5**	**101.9**	**144.7**	**104.9**
	+SD	**12.7**	**8.1**	**13.1**	**7.3**	**13.5**	**6.8**	**12.6**	**8.8**	**12.0**	**7.9**
Mobile Users (N = 36)	**Mean**	**135.6**	**86.7**	**140.9**	**92.1**	**146.3**	**97.9**	**151.7**	**102.8**	**155.9**	**107.8**
	+SD	**11.4**	**7.2**	**12.3**	**7.7**	**12.5**	**8.9**	**13.4**	**9.5**	**13.4**	**9.6**

Table 3: Autonomic function assessment: Heart rate response to standing

Group ⇩		**Heart Rate Response to Standing**

		Shortest R-R Interval (15th Beat)	Longest R-R Interval (30th Beat)	Ratio
Control Group (N = 34)	Mean	0.68	0.85	0.765
	+SD	+0.12	+0.13	+0.125
Mobile Users (N = 36)	Mean	0.69	0.83	0.76
	+SD	+0.08	+0.14	+0.11

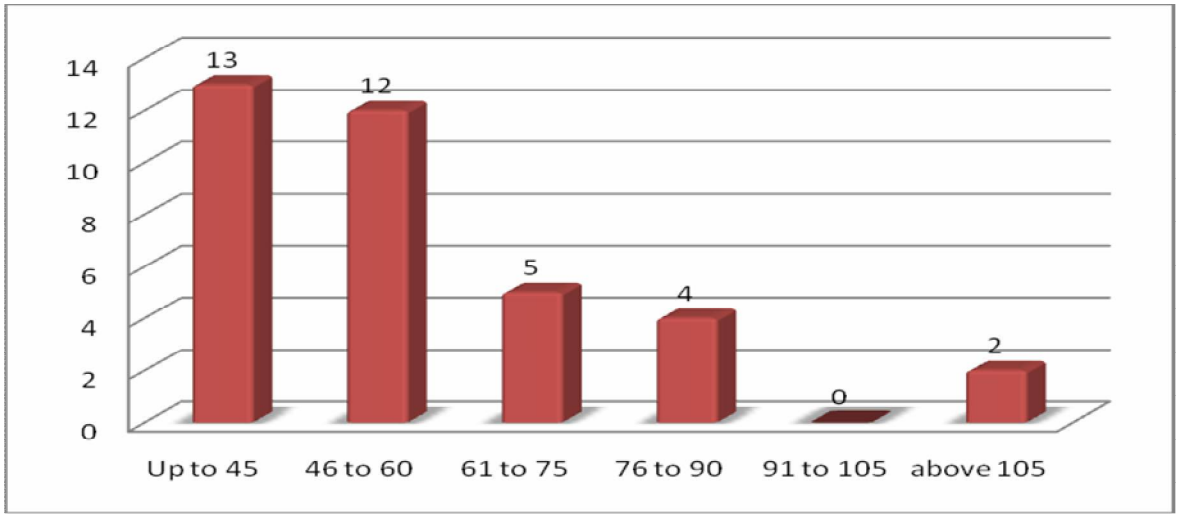
Table 4: Autonomic function assessment: Heart rate response to Valsalva maneuver

Heart Rate Response to VALSALVA Maneuver				
	Variable	N	Mean	+SD
During Maneuver Shortest R-R Interval	Control	34	0.7471	0.11514
	Mobile User	36	0.7544	0.08453
After Maneuver Longest R-R Interval	Control	34	0.9659	0.12422
	Mobile User	36	0.9622	0.10071

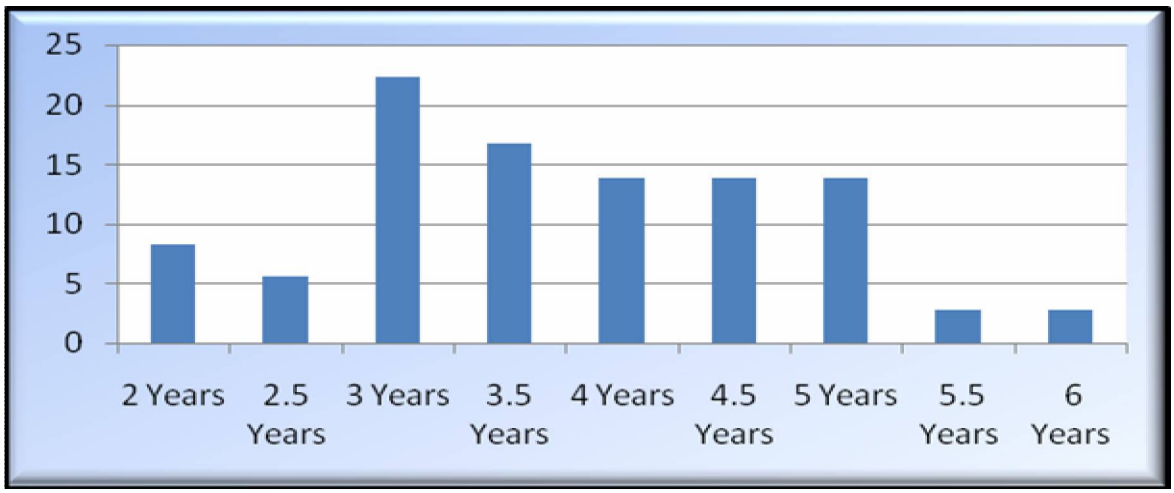
Table 5: ANS response to different tests

Group	Sympathetic Test				Parasympathetic Test				Total Abnormal Test	
	BP Response to Standing		Sustained Handgrip Test		HR Response to Standing		VALSALVA Manoeuver			
	B	A	B	A	B	A	B	A	B	A
Control Group	00	00	01	02	00	00	01	00	02	02
Mobile Users	07	03	01	01	00	06	02	02	10	12

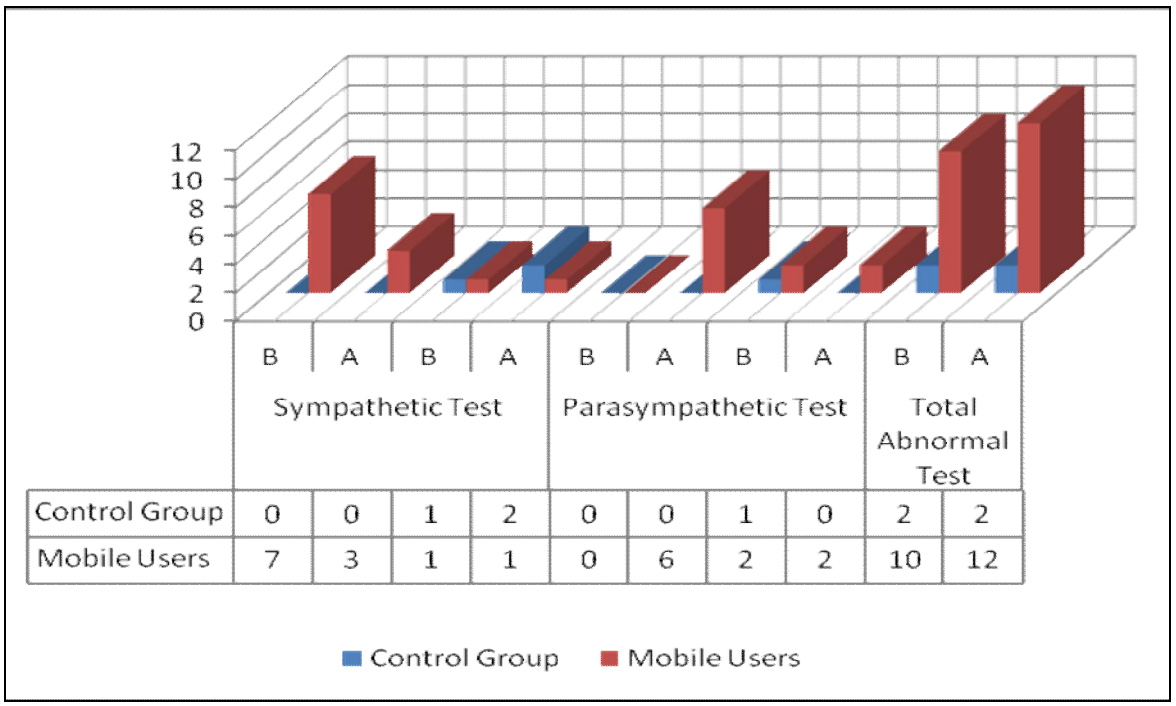
Graph 1: Total use of mobile phone per months (duration in hrs. Vs frequency)



Graph 2: Duration of mobile phone use (using since)



Graph 3: Response to different ANS tests



	B	A	B	A	B	A	B	A	B	A
	Sympathetic Test				Parasympathetic Test				Total Abnormal Test	
Control Group	0	0	1	2	0	0	1	0	2	2
Mobile Users	7	3	1	1	0	6	2	2	10	12

DISCUSSION

Alteration of ANS function will greatly influence the functions of vital organs especially the heart i.e. cardiovascular system. The present study was designed to test the autonomic activities in 36 normal health mobile phone users and there comparison with 34 control group. Out of four autonomic function test abnormal result in more than two tests consider as autonomic dysfunction.

Average values of results and autonomic dysfunction may significantly incline towards exposure of electromagnetic radiation emitted by mobile phone. Therefore, our experimental protocol seems minimally biased since we confirmed that there were changes in ANS functioning due to frequent exposure to electromagnetic radiation emitted by mobile phone. Noted changes are statistically analyzed and conclusion of the present study was compared with previous studies.

In normal the sitting – lying differences is due to hydrostatic influence acting mainly through the carotid sinus reflex. The national guidelines explain that diastolic blood pressure is approximately 5 mm/Hg higher in sitting position than when lying down and systolic pressure is 8 mm/Hg higher in the lying-down position than in the sitting position, but only when the person taking the blood pressure measurement positions the patient's arm so that it is at the same level as the right atrium of the heart (Leigh Ann Morgan, 2004) and similar result where found in our study during resting stage but the blood pressure i.e. systolic as well as diastolic value what we reported in mobile phone user are higher than the normal or control group. German investigators, Frey et al., (1998) report that exposure to electromagnetic fields during mobile phone use may increase resting blood pressure. It causes an increase in sympathetic efferent activity with increases in resting blood pressure between 5 and 10 mm Hg (Frey et al., 1998). Braune et al. (1998) and Stacy Eltiti et al. (2007) have reported acute effects on blood pressure in human volunteers exposed to a conventional GSM digital mobile phone. In our study resting blood pressure i.e. systolic and diastolic blood pressure values were observed to be significantly increased in mobile user group as compared to the control group.

Effects of mobile phone radiations on the autonomic nervous system have been reported to have its impact on the cardiovascular system. Change in blood pressure due to mobile phone radiations and base station radiations suggesting the slight increase in resting blood pressure was already suggested by Braune et al. (1998) and Stacy Eltiti et al. (2007). Andrzejak R et al. (2008) estimated the influence of the mobile call on heart rate variability (HRV) and suggested the average normal sinus RR intervals were increased significantly. This study also points that the call with a mobile phone not only changes the RR interval but also changes the heart rate. The change in heart rate is the property of autonomic nervous system which also indicates that the mobile phone radiations may change the autonomic balance of the mobile user. Magda Havas (2010) also clearly showed a relationship between exposure of the subject to radiations and changes in the autonomic function system that can lead to heart irregularities (alters heart rate or resting blood pressure), dizziness, nausea, fatigue, sleep disturbances, profuse sweating and fainting spells.

In our study resting blood pressure i.e. systolic and diastolic blood pressure values were observed to be significantly increased in mobile phone user group as compared to the control group, which may be due to more pronounced vasoconstriction and carotid sinus reflex. The difference in our study with the other investigators is that we prolonged the exposure of the subjects for different duration for more than one year to observe the effect on subjects on being exposed to mobile cell use for a longer duration. Our observations reveal autonomic function changes do not alter in all the subjects but if we compare the study group with the controls than we find the values are significantly increased.

SUMMARY & CONCLUSION

Prolong exposure to electromagnetic radiation emitted by mobile phone and their responses to sympathetic and parasympathetic function were changed. This shows that prolonged exposure capable of causing hazards but required more time to do so. Although Rf radiation exposures due to mobile phone radiation are very low, but once the emitted energy get absorbed by the biological matter can cause severe and long-term damage to health of human being. It might take long period for the damage to fabricate evident symptoms. So further detail and prolong duration study should be carry out on experimental animal (i.e. histological study) to verify the said effect. Based on this, we would like to conclude that the

persistent & prolonged exposure to electromagnetic radiation emitted by mobile phone is a risk factor.

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