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Effect of Electromagnetic Fields Emitted By Mobile Phone on Cardiovascular Autonomic Function Tests

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ABSTRACT:
In recent decades, wireless communication technology, such as cell phones and the internet, has evolved substantially.In India, studies on electromagnetic radiation began in the last decade, thanks to mobile phone technology. Although mobile phone radiation is relatively low, it can have a detrimental influence on human health once the energy released by the phone is absorbed by biological matter. This study evaluates the effect of electromagnetic fields emitted by mobile phone on cardio vascular autonomic function tests on normal healthy individuals. A total of 300 healthy individuals of age group of 18- to 40- years after receiving informed permission, were divided into two groups: -Group A: which usages cell phone less than one hour per day. Group B: which usages cell phone more than one hour per day. All cardiovascular autonomic function tests along with anthropometric parameters were evaluated at baseline and after one year. All the sympathetic and parasympathetic tests are statistically insignificant when compared with baseline and after one year.

Key Words: Body Mass Index, Diastolic Blood Pressure, Electro-Cardiogram, Electro-Magnetic Field, Global System of Mobile communication, High Frequency Hearing LossHeart Rate Variability, Noise induced hearing loss, Radio-Frequency Electro-Magnetic Field

I. INTRODUCTION

In today's modern period, life would be tough without technology, and new research with improved technologies is being developed on a daily basis. In recent decades, wireless communication technology, such as cell phones and the internet, has evolved substantially.Different types of communication services are predicted to emerge in the future, and it is difficult to imagine living without these technologies. In India, studies on electromagnetic radiation began in the last decade, thanks to mobile phone technology. Although mobile phone radiation is relatively low, it can have a detrimental influence on human health once the energy released by the phone is absorbed by biological matter.[1]

Electromagnetic radiation from mobile phones causes a variety of negative health effects, including flu-like symptoms, reduced sperm quality, memory and sleep problems, behavioral changes in children exposed to RF prenatally, and the development of brain tumours.[2,3,4] RF-EMF radiation from mobile phones has been shown to affect the autonomic balance in healthy subjects.[1,5] It can affect intracellular signaling pathways by altering Ca2+ permeability across cell membranes and cellular calcium levels. In terms of the cardiovascular consequences of RF-EMF generated by cell phones, it may cause cardiac pacemakers and other implantable rhythm devices to malfunction.[6]

Electromagnetic waves are used to transfer signals from mobile phones to cell tower to cell phone and rom cell phone to cell tower. Although the usage of a mobile phone can save a person's life in an emergency and assist them improve their lifestyle in certain areas, there has been a worry about the possible negative health effects with its usage since the inception of this technology. During the use of a mobile phone, they are close to head, one worry has been raised that the radio frequency waves generated during use may increase the risk of brain cancer. Studies have found increased risk of glioma but statistically significant difference was not noted.[2] RF-EMF systems have a higher risk of exposure than other types of RF systems. Most mobile phones include a tiny antenna since these antennas are so close to the user's head, they produce more RF exposure than other types of RF systems.[4]

One of the most common ways for assessing autonomic modulations of the heart is to measure heart rate variability (HRV). It identifies cardiac autonomic control and shows normalized autonomic activity. As the mobile phones are a possible source of electromagnetic interference,

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there is growing evidence that the EMF generated by them interacts with the human organism. As a result, the cardiovascular system might be a target for mobile phone emitted RF-EMF.[7]

II. MATERIAL AND METHOD

Data collection

A cohort study was design to evaluate the effect that include the 300 normal subjects of Bikaner division. In this study samples were collected by Systemic random sampling technique. A total of 300 healthy individuals of age group of 18- to 40- years after receiving informed permission, those who met my inclusion and exclusion criteria were recruited in this study. Study participants were grouped in two groups:

Group A: which usages cell phone less than one hour per day.

Group B: which usages cell phone more than one hour per day

Subjects that refuseto sign a written, informed consent form and Known case of hypertension, pulmonary tuberculosis, chronic bronchitis or any other uncontrolled systemic or psychiatric disease, diabetes mellitus, asthma were excluded from the study.

Methodology:

Anthropometric data, as well as clinical examinations and assessments of cardiovascular autonomic functioning, were included in the study.

A. Anthropometric parameters:

This includes weight, Height, Body mass index.

B. **Clinical examination:** This included measurement of blood pressure at baseline and 1-year follow-up.

C. **Cardiovascular autonomic reactivity:**

The following tests were used to assess Sympathetic activity:

1. Change in blood pressure in response to standing-up
2. Change in blood pressure in response to isometric handgrip test

The following tests were used to assess parasympathetic activity:

1. Lying to standing test (LST)
2. Heart rate response to Valsalva maneuver
3. Deep Breathing test (DBT)

Statistical analysis

The observations and results wereanalysed using standard statistical procedures. Diverse factors were averaged across different groups of individuals.In order to compare the differences between the means, the student's paired 't' test was applied. In all cases, p values were calculated with two tails, and a value of less than 0.05 was judged to be statistically significant.

III. OBSERVATIONS TABLE AND RESULT

Table 1

	Group A	Group B	P value
Mean weight	70.6±5.92	71.88±6.54	0.08
Mean height	173.31±6.05	174.1±5.8	0.25
Mean BMI	23.48±1.04	23.68±0.89	0.07
Mean SBP	119.9±4.39	120.1±4.2	0.76
Mean DBP	79.6±2.9	79.8±3.2	0.67

Table 1 shows mean anthropometric parameters of study participants of group A versus group B at the baseline.

Table 2

	Group A at follow-up	Group B at follow-up	P value
Mean weight	70.83±5.41	72.03±5.7	0.06
Mean height	173.31±6.05	174.1±5.8	0.25
Mean BMI	23.56±0.86	23.59±1.77	0.84
Mean SBP	119.6±4.29	119.72±4.04	0.93
Mean DBP	80.22±2.9	79.7±3.24	0.15

Table 2 shows the mean value comparison of Anthropometric parameters of study participants of group A versus group B at 1 year follow-up. All the values are statistically insignificant.

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Table 3

	Group A	Group B	P value
Sympathetic activity:			
Mean difference in SBP after standing	5.4±2.15	5.24±2.15	0.52
Mean difference in DBP after standing	1.94±1.77	1.69±1.58	0.19
Difference in DBP on HGT	15.41±2.57	15.40±2.23	0.96
Parasympathetic activity:			
Lying to standing test(30:15 ratio)	1.0419±0.0057	1.0416±0.005	0.67
HR response to Valsalva manoeuvre	1.243±0.0187	1.242±0.0182	0.53
Deep breathing test	1.24±0.019	1.241±0.02	0.53

Table 3 shows the mean value of Autonomic nervous system activity of study participants of group A versus Group B at baseline. All the values are statistically insignificant at baseline.

Table 4

	Group A at baseline	Group A at 1-year follow-up	P value
Sympathetic activity:			
Mean difference in SBP after standing	5.4±2.15	5.29±2.0	0.52
Mean difference in DBP after standing	1.94±1.77	2.05±1.73	0.50
Difference in DBP on HGT	15.41±2.57	15.52±2.90	0.66
Parasympathetic activity:			
Lying to standing test	1.0419±0.0057	1.0424±0.0059	0.22
HR response to Valsalva manoeuvre	1.243±0.0187	1.242±0.018	0.89
Deep breathing test	1.24±0.019	1.244±0.02	0.50

Table 4 shows the mean value comparison of Autonomic nervous system activity of study participants of group A at baseline versus Group A at 1-year follow-up. All the values are statistically insignificant.

Table 5

	Group B at baseline	Group B at 1-year follow-up	P value
Sympathetic activity:			
Mean difference in SBPafter standing	5.24±2.15	4.93±2.18	0.09
Mean difference in DBP after standing	1.69±1.58	1.90±1.45	0.14
Difference in DBP on HGT	15.4±2.23	14.92±2.79	0.07

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Parasympathetic activity:			
Lying to standing test	1.0416±0.005	1.0424±0.0059	0.09
HR response to Valsalva manoeuvre	1.242±0.0182	1.242±0.018	0.95
Deep breathing test	1.241±0.02	1.244±0.02	0.11

Table 5 shows the mean value comparison of Autonomic nervous system activity of study participants of group B at baseline versus Group B at 1-year follow-up. All the values the statistically insignificant.

Table 6

	Group A at 1-year follow-up	**Group B at 1-year follow-up**	**P value**
Sympathetic activity:			
Mean difference in SBP after standing	5.29±2.0	4.93±2.18	0.13
Mean difference in DBP after standing	2.05±1.73	1.90±1.45	0.42
Difference in DBP on HGT	15.52±2.90	14.92±2.79	0.06
Parasympathetic activity:			
Lying to standing test	1.0416±0.0055	1.0424±0.0059	0.23
HR response to Valsalva manoeuvre	1.243±0.017	1.242±0.018	0.60
Deep breathing test	1.241±0.018	1.244±0.02	0.14

Table 6 shows the mean value comparison of Autonomic system activity of study participants of group A versus Group B at 1 year follow-up. All he data are statistically insignificant.

IV. DISCUSSION: -

Effect of mobile phone's RF-EMF exposure on autonomic nervous system can cause varied manifestations. The effect on cardiovascular system will be among those which will be most apparent. The purpose of this study was to test the autonomic nervous system among healthy individuals who were using mobile phones for different duration every day. We divided the study participants in two groups, group A were the participants who were using the mobile phone for less than an hour every day while group B were the participants who were using the mobile phone for more than an hour every day.

The anthropometric parameters of both groups including weight, height, BMI, systolic and diastolic BP were noted both at the baseline and 1-year follow-up examination. No statistically significant difference was noted at baseline (table 1) making the groups comparable for study. Both

the groups had similar demographic characteristics. At 1-year follow-up in either of the groups, no significant change was noted. Both groups remained comparable even at the 1-year follow-up visit. The RF-RMF exposure from mobile phones was thus not found to be affecting these anthropometric parameters.

The functions of autonomic nervous system were assessed via tests for sympathetic nervous system including measurement of systolic and diastolic BP, difference in BP on standing-up, difference in diastolic BP on hand-grip test and tests for diastolic nervous system including response of heart rate to lying to 30:15 ratio, VM, and DBT. In previous studies reported in literature, submission to the electromagnetic field from cell phones has been shown to associated with raised resting blood pressure by Frey et al.[8] but in our study the mean resting SBP at the baseline evaluation was 119.9±4.39mmHg in group A and 120.1±4.20mm Hg in group B while mean resting diastolic blood pressure was 79.6±2.9 and 79.8±3.2mmHg in group A and B, respectively. Thus, the participants in both the groups had resting blood pressures within the normal range. Other study groups including Braune et al.[9] (1998) Eltiti et al[10] too have shown increased resting blood pressures associated with mobile phone usage. In our study, the difference in SBP on standing-up was 5.4±2.15 in group A and 5.24±2.15 in group B, the difference being statistically insignificant. A rise of 15.41±2.57mmHg in DBP was seen on hand-grip test in group A, while it was 15.40±2.23mmHg in group B. Rise in DBP after hand-grip test was seen to be within the normal physiological limits and difference between both the groups was also not significant making both the groups comparable. Both the groups were shown to remain comparable even at the end of 1-year. The mean difference in SBP on standing-up was shown to decrease from 5.24±2.15 to 4.93±2.18 in group B by the end of 1-year and statistically the difference was nonsignificant. The effect of RF-EMF exposure from mobile phones on blood pressure has differing reports. Vangelova et al.[11] noted that EMF exposure caused a rise in the blood pressure. Tahvanainen et al.[12] reported no significant effect on the blood pressure due to mobile phones with 900MHz or 1800MHz frequencies, which are the generally used frequencies by mobile phones working on global system of mobile communication (GSM) technology.

HRV is another important tool for assessment the effect on autonomic nervous system. RF-EMF from mobile phones may interact with the human body tissues as it acts as a possible source of interference. Andrzejak et al.[1] (2008) noted a significant increase in the average normal sinus RR intervals and thus causing a change in the heart rate. Another study by Havas et al.[13] (2010) also showed an association between heart rate abnormalities and exposure to RF-EMF exposure from mobile phones. In our study we analysed the heart rate variation in response to various activities like lying to standing, VM and DBT. We found no correlation between the heart rate variability parameters and the duration of mobile phone usage over a period of 1-year. Heart rate variability is a physiological response due to the effect of autonomic nervous system on sinus node activity of human heart and thus causing variation in RR intervals during breathing and while performing activities. A variation beyond the physiological limits is considered as abnormal and, in our study, both the inter-group and intra-group comparison at baseline and 1-year follow-ups were analysed statistically. The difference in any of the scenarios was not statistically significant. RF-EMF exposure from the mobile phones thus may not be sufficient to cause a heart rate variability beyond physiological limits in healthy individuals. Studies available in literature regarding effect of mobile phones on heart rate variability have contradictory conclusions. Yildiz et al.[14] noted that there was no strong association between the HRV and mobile phone usage. Bortkiewicz et al.[15] noted that a signification causality could be ascertained between occupational exposure to electromagnetic field exposure and heart rate variability. In yet another study by Parazzini et al.[16] no statistically significant association was seen between heart rate variability and EMF exposure. Baructu et al.[7] reported that no significant cardiac autonomic modulation was seen due to EF-EMF exposure from mobile phones in healthy study subjects. A study on effect of EMF due to mobile phones on cardiac electrical activity showed that there was no significant association between the two.[17]

No case of any arrhythmias was noted in any of the study participants in both the groups. Our study points that the RF-EMF exposure from mobile phones may not be significant enough to cause a disturbance in the autonomic nervous system.

V. CONCLUSION

With growing usage of mobile phones in daily life it becomes imperative to ascertain the outcome of mobile phone's RF-EMF submission on healthy human beings. The autonomic nervous system regulation of heart function was not

significantly affected by such exposure, according to the current study.

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