

## A Study on Effect of Smart Phone Usage on Cardiovascular and Hematological Parameters in Adult Population

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Received: 06-09-2021 / Revised: 18-10-2021 / Accepted: 12-11-2021

### Abstract

**Background:** Worldwide, mobile phone usage has increased dramatically which could have affected the health of the people in India and across the globe as well. Mobile phone radiation may impact cardiovascular parameters like heart rate and other physiological parameters<sup>1</sup> therefore it is highly suggested to explore the impact of mobile phone usage on the health of the human beings. **Materials & methods:** The present study was conducted at Integral university campus, Lucknow (From January 2019 to June 2019) in the Department of Physiology of IIMS&R, Lucknow. A total of 197 adult population were recruited who underwent monitoring for the study purposes. Blood pressure both systolic and diastolic blood pressure (SBP, DBP) was recorded using mercury sphygmomanometer. Total white blood cells (WBC) count was done by Haemocytometer method using Turk's fluid as diluent. Cells were counted manually using compound microscope. **Results:** In our study, Subjects (n=21) whose systolic blood pressure were recorded to be >140 mmHg accounting for 10.65% of total subjects. Subjects (n=2) whose diastolic blood pressure were recorded >90 mmHg whose percentage is 1.01 of the total subjects studied. After adjustment for age and sex, the positive correlation was found between the duration of mobile phone usage and SBP, DBP with a p value of 0.169 and 0.386 respectively. Total WBC count was found to be higher than normal range in two number of subjects with a p value of 0.715. **Conclusion:** From this study, it can be concluded that the electromagnetic field created by mobile phone's usage can change blood pressure (SBP, DBP) and can induce changes in the population of white blood cells.

**Keywords:** Systolic blood pressure, Diastolic blood pressure, White blood cells, Electromagnetic field.

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### Introduction

Mobile phones or different electronic gadgets have become an integral part of an individual life. With the rapid evolution in mobile technology there have been increase in frequency of radiation which is emitted. Usually, the frequency of mobile phone radiation falls in the range of 900 MHz to 2.5 GHz[2]. With the rapid rise in mobile phone usage throughout the world, its harmful effects are also being studied and contemplated. Electro-magnetic radiation emitted by mobile phones may cause symptoms like headache, nausea, fatigue, dizziness and loss of memory collectively called "electromagnetic hypersensitivity"[3]. Electromagnetic radiation is the flow of photons in the space. Each photon contains a certain amount of energy and different types of radiation consists of the amount of energy which is found in the photons. The electromagnetic fields emitted by cellular phones may alter the working of cardiac pacemakers and other implantable medical devices[4]. The DNA is the genetic material of cell that is

sensitive to ionizing radiation[5]. Ionizing radiation waves contain high energy that overcome the binding energy of electrons in atoms/molecules and creates ions. The Non-ionizing radiation waves do not carry high energy to make ions from atoms or molecules. These are low amount of frequency radiations, such as radio waves, microwaves, infrared waves, etc[6].

The regular and long term use of mobile phones can have negative impact upon biological system especially on autonomic nervous system[7]. Mobile phones do not use any cable, hence are functioning on the basis of wireless radio-frequency wave. Electromagnetic radiation emitted from mobile phones may have influences on autonomic, cardiovascular, endocrine, blood, and reproductive system[8]. Therefore this study was conducted to determine the effects of radiation emitted by mobile phones on cardiovascular and hematological parameters among young adult population residing in Integral university campus in Lucknow.

### Materials & methods

This study was conducted at Integral university campus, Lucknow (from January 2019 to June 2019) in the Department of Physiology of IIMS&R, Lucknow. The sample was derived from the study population of 197 subjects who were using mobile phone for last 5 years and underwent monitoring for the study purposes. Blood pressure of the subjects were recorded in the sitting posture by Sphygmomanometer (Mercury) and we have given 5 minutes of rest before recording of Blood Pressure. All the participants were healthy,

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and none of them were on any long term medication. Total WBC count was done by Haemocytometer method using Turk's fluid as diluents. Cells were counted manually using compound microscope in the Haematology laboratory in the Department of Physiology, IIMS&R.

The duration of mobile phone usage per day were determined retrospectively from the individual's telephone billing records. Daily duration of mobile phone use was calculated automatically by

dividing the total duration of calls. The continuous duration (in hours) of mobile phone use by the subjects was considered for estimation and further analysis.

**Statistical analysis**

The data were analyzed using statistical package for social science software. Appropriate statistical chi-square test was used to analyze the data. P-value

<.05 was taken as significant.

**Results**

**Table 1: Number (n) and percentage (%) of Age group distribution of the subjects**

Age (year)	No. of Subjects (n)	Percentage (%)
<20	11	5.58
21-25	168	85.27
26-30	15	7.61
31-35	3	1.52

**As per table-1**

- 11 no. of subjects were ≤20 years of age constituting 5.58%
- 168 no. of subjects were 21-25 years of age constituting 85.27%
- 15 no. of subjects were 26-30 years of age constituting 7.61%
- 3 (n) no. of subjects are 31-35 years of age constituting 1.52%

**Table 2: Number (n) and percentage (%) of Gender distribution of the subjects**

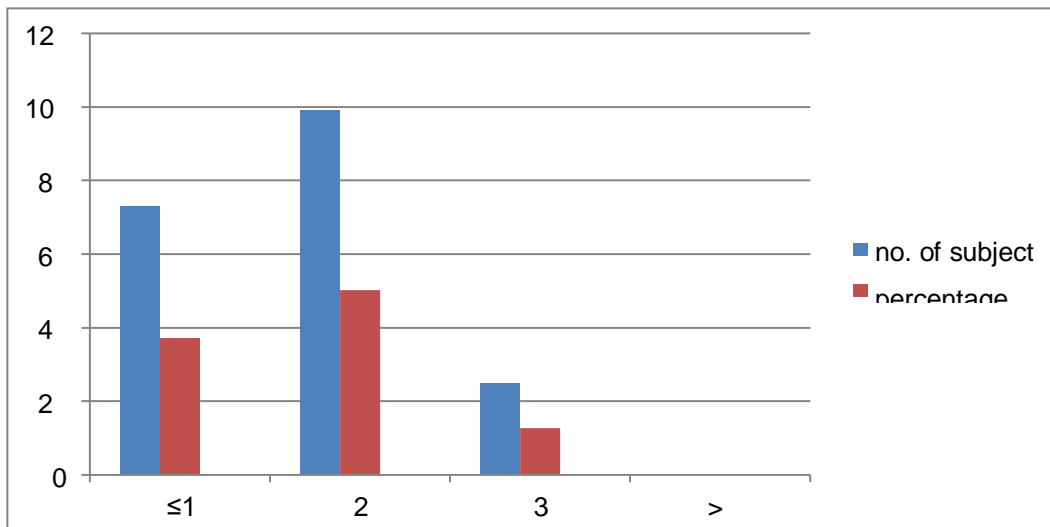
Gender	No. of Subjects (n)	Percentage (%)
Male	172	87.30
Female	25	12.69

**As per table-2**

- 172 no. of subjects were male and 25 were female whose percentage (87.30% and 12.69% respectively of the total no. of subjects.

**Table 3: Continuous duration of mobile phone usage (hours) in number (n) and percentage of subjects respectively**

Duration of mobile phone usage (continuous in hours)	No. of Subjects (n)	Percentage (%)
≤ 1	72	36.54
2	99	50.25
3	24	12.18
>4	0	0



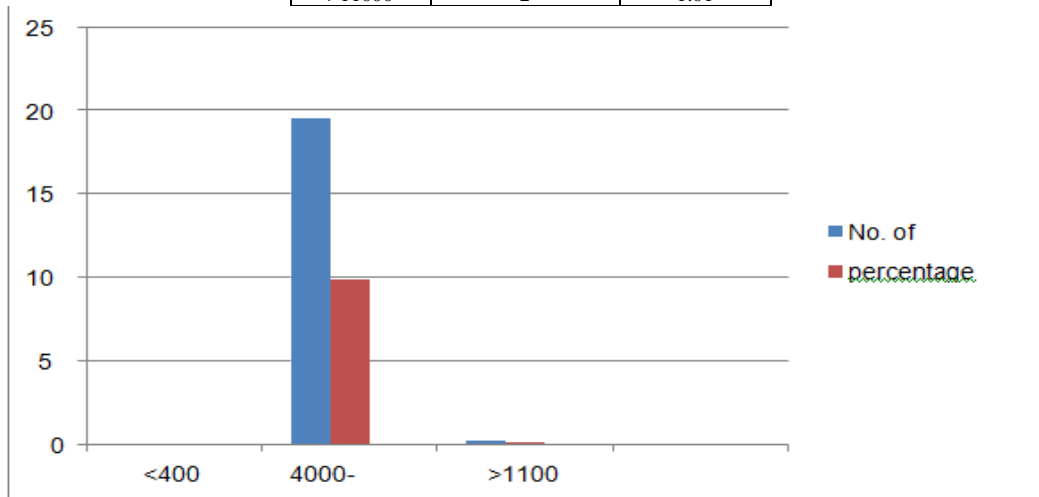
**Fig 3: Continuous duration of mobile phone usage (hours) are number (n) and percentage (%) of subjects with their respectively.**

**As per table-3 and figure-3**

- 72 no. of subject's duration of mobile phone usage were ≤1 hour i.e 36.54% of total no. of subjects.
- 99 no. of subject's duration of mobile phone usage were 2 hours i.e, 50.25% of total subjects.
- 24 no. of subject's duration of mobile phone usage were 3 hours i.e 12.18% of the total subjects.
- 0 (n) no. of subject's duration of usage mobile phone was ≥4 hours

**Table 4: Number (n) and percentage (%) of subjects with their leukocyte (WBC) count respectively**

TLC (Cumm)	No. of Subjects (n)	Percentage (%)
<4000	0	0
4000-11000	195	98.98
>11000	2	1.01



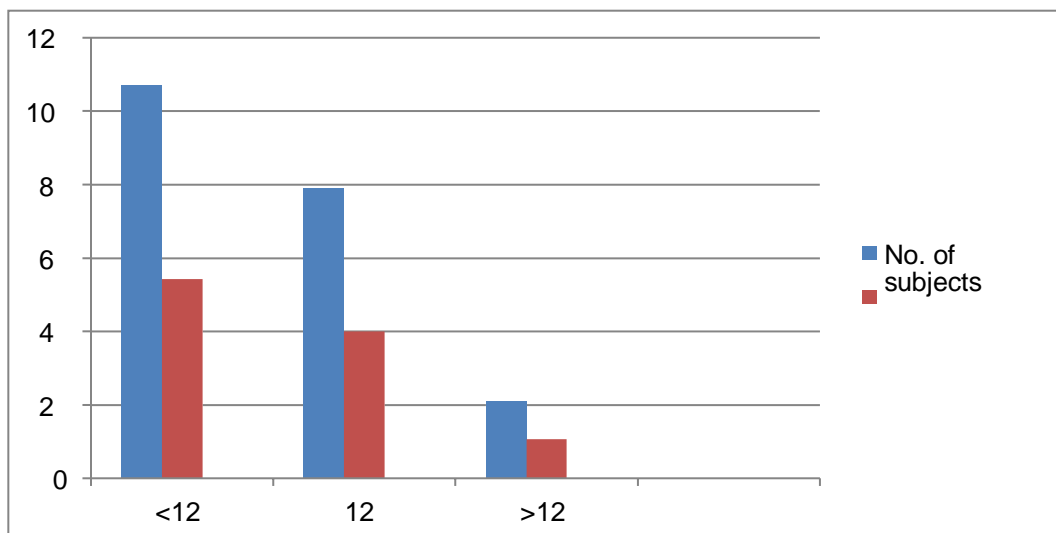
**Fig 4: Number (n) and percentage (%) of subjects with their TLC (cumm/dl) respectively.**

As per table-4 and figure-4

- 0 no. of subjects had total leukocyte count <4000/ Cumm.
- 195 no. of subjects had total leukocyte count 4000-11000/ Cumm i.e, 98.98% of the total subjects.
- 2 no. of subjects had total leukocyte count >11000/ Cumm i.e, 1.01% of the total subjects.

**Table-5: Number (n) and percentage (%) of subjects with their systolic blood pressure respectively**

Systolic blood pressure (mmHg)	No. of Subjects (n)	Percentage (%)
100-120	107	54.31
121-140	79	40.10
>140	21	10.65



**Fig 5: Number (n) and percentage (%) of subjects with their systolic blood pressure (SBP) respectively.**

As per table-5 and figure-5

- 107 no. of subjects had systolic blood pressure 100-120 mmHg i.e, 54.31% of total subjects.
- 79 no. of subjects had systolic blood pressure 121-140 mmHg i.e, 40.10% of total subjects.
- 21 no. of subjects had systolic blood pressure >141 mmHg i.e, 10.65% of total subjects.

**Table-6: Number (n) and percentage (%) of subjects with their diastolic blood pressure respectively**

Diastolic blood pressure (mmHg)	No. of Subjects (n)	Percentage (%)
70-80	98	49.74
81-90	97	49.23
>90	2	1.01

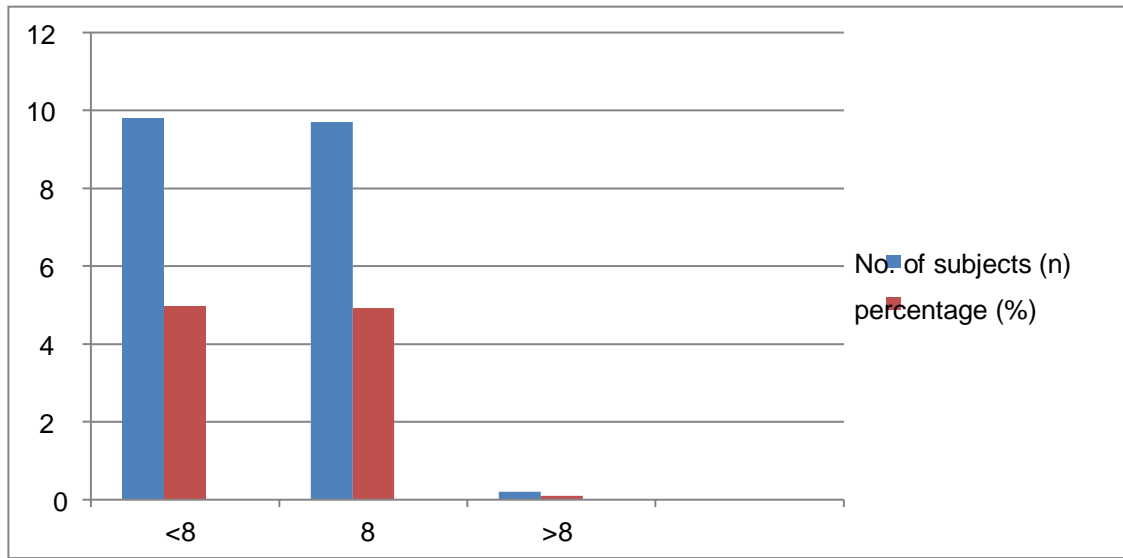


Fig 6: Number (n) and percentage (%) of subjects with their diastolic blood pressure (DBP) respectively

As per table-6 and figure-6

- 98 no. of subjects had diastolic blood pressure 70-80 mmHg i.e,49.74% of total subjects.
- 97 no. of subjects had diastolic blood pressure 81-90 mmHg i.e,49.23% of total subjects.
- 2 no. of subjects had diastolic blood pressure >90 mmHg i.e,1.01% of total subjects.

Table-7: Duration of continuous usage (hours) of mobile phone by the subjects and their systolic blood pressure (SBP mmHg)

Duration (Hours)	No. of subjects	Systolic blood pressure (mmHg)		Total	Chi- square test value	p-value
		100-120	121-140			
≤1	Count	69	5	74	1.896	.169
2-3	Count	107	16	123		
Total	Count	176	21	197		

As per table-7

- 69 no. of subjects who have used mobile phone ≤1 hour duration their systolic blood pressure was 100-120 mmHg and 5 no. of subjects had their SBP 121-140 mmHg.
- 107 no. of subjects who had used mobile phone for 2-3 hours duration, their systolic blood pressure was 100-120 mmHg and 16 no. of subjects had their SBP 121-140 mmHg.
- P-value was 0.169, that is >0.05 and hence the result found above was not significant

Table-8: Duration of continuous usage (hours) of mobile phone by the subjects and their diastolic blood pressure (DBP mmHg)

Duration (hours)	Diastolic BP (mmHg)			Total no. of subjects	Chi-square test	p-value
	70-80	81-90	>91			
≤1	40	34	0	74	1.906	.386
2-3	58	63	2	123		
Total	98	97	2	197		

As per table-8

- 40 no. of subjects who had used mobile phone for ≤1 hour duration their diastolic blood pressure was 70-80 mmHg and 34 no. of subjects had DBP 81-90 mmHg.
- 58 no. of subjects who had used mobile phone for 2-3 hours duration their diastolic blood pressure was 70-80 (mmHg) and 63 no. of subjects had DBP 81-90 mmHg.
- P-value was 0.386, that is >0.05 and hence the result found above was not significant

Table 9: Duration of continuous usage (hours) of mobile phone by the subjects and their total leukocyte count (TLC) (Cumm/dl)

Duration (hours)	TLC (Cumm/dl)		Total no. of subjects	Chi-square test	p-value
	4000-11000	>11000			
≤1	73	1	74	.133	.715
2-3	122	1	123		
Total	195	2	197		

As per table-9

- 73 no. of subjects who had used mobile phones for ≤1 hours duration, their total leukocyte count (TLC) was 4000-11000/ Cumm and 1 no. of subjects had TLC >11000 / Cumm
- 122 no. of subjects who used mobile phones for 2-3 hours duration their total leukocyte count (TLC) was 4000-11000/ Cumm and 1 no. of subjects had TLC 11000/ Cumm
- P-value was 0.715, that is >0.05 and hence the result found

above was not significant.

### Discussion

This study was carried out to evaluate effects of mobile phone usage among adult population residing in Integral University campus in Lucknow. Our findings suggested non-significant effect of mobile usage on WBC count among subjects studied. Majority of the subjects in this study used mobile phones for continuous 2 hours duration per day. This short period of exposure of electromagnetic radiation to the body may not be adequate factor for decreasing or increasing total WBC count among subjects studied. However, 2 subjects reported to have increased WBC count more than normal range. The possible reason for this variation in the finding of WBC count, may be individual's phenotype or genotype or environmental factors or may be the type of smart phones and their emitted type of radiation or their thermal or non-thermal effects subsequently on different types of blood cells. According to a study conducted in Baghdad, Iraq, on smoker and non-smoker subjects, study groups were exposed to gamma radiation. It was found that, after increasing the doses of  $\gamma$ -rays, that resulted in decline in the values of WBCs, lymphocytes, and neutrophils as reported among smokers as compared to that of non-smokers and this confirms that these cells are more fragile, weak, and less tolerant to external stimuli such as gamma rays that cause damage at cellular level and are penetrating, causing diffuse damage throughout the body. Low levels of  $\gamma$ -rays cause a stochastic health risk, which for radiation dose assessment is defined as the probability of cancer induction and genetic damage. High doses of it produces deterministic effects, which is the severity of acute tissue damage that is certain to happen[9]. As it were reported in previous studies conducted by Sih et al (2017)[9] our findings are not similar in relation to the haematological parameter. Our findings in terms of haematological parameter (WBC total counts) is similar to the study that was conducted by Sani A. et al (2018) on effects of electromagnetic radiation of mobile phones on haematological parameters among male Albino Rats[10]. Our findings in terms of haematological parameters is similar to a previous study conducted by Suleyman et al (2002) on effects of extremely low frequency electromagnetic fields on hematological and immunological parameters in welders[11]. The association between mobile phone usage and hypertension is significant because it is a risk factor for development of cardiovascular diseases. The rise of mobile phone usage has led to the concerns over their possible adverse effects on human health[12]. Because, mobile phones are held against the head, many studies have examined the risks that these phones pose on the brain, including cognitive functions and sleep. Some studies have shown that chronic exposure to low-intensity electromagnetic field (EMF) is associated with increased risk of cardiac arrhythmias, acute myocardial infarction, cardiovascular mortality and alteration of diurnal variation of blood pressure[12]. Our findings in context with cardiovascular parameters coincide to that of the previous study conducted by Aghav et al (2018) on environmental pollution due to mobile phone's radiation effects on blood pressure[13]. Our findings in context with cardiovascular parameters is similar to that of the previous study conducted by Basandrai et al (2017) on non-thermal effects of mobile phones radiation on human heart rate and blood pressure. Our findings in context with cardiovascular parameters.

### Conclusion

Majority of the subjects studied in our study shown their WBC total count within normal physiological range, except two subjects whose WBC total count was found to be increased more than normal range. Majority of the subjects studied in our study shown their blood pressure (SBP & DBP) parameters within normal physiological range, except twenty one subjects whose SBP was found to be increased while two subjects whose DBP was found to

be increased more than normal range. The present study demonstrates that a long-term duration of Mobile phone use may influence and change the autonomic balance in favor of an increased sympathetic tone. An increase in the sympathetic tone and a concomitant decrease in the parasympathetic tone are reported to be measured among the subjects who have used the mobile phones for prolonged period of time.

### Limitations

In the present study, majority of the subjects were not using mobile phones for longer duration of time and hence the effects of prolonged use of mobile phones could not be studied. Further study is required involving the heart rate variable (HRV) analysis on large sample size to explore the effects of prolonged use of smart/mobile phones among population across all age groups and sexes.

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**Conflict of Interest: Nil Source of support: Nil**