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Original Article

A study on the impact of smartphone use on haematological and cardiovascular parameters in the adult population: A cross-sectional study.

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Abstract

Background

The increasing use of mobile phones has raised concerns about their potential health effects, particularly on cardiovascular, inflammatory, and hematological parameters. This study investigates the impact of mobile phone usage on WBC count and blood pressure among adults.

Methods

This study was conducted at IGIMS, Patna, to assess the effects of mobile phone radiation on cardiovascular, inflammatory, and hematological parameters. Blood pressure was measured using a mercury sphygmomanometer, and the WBC count was analyzed using the hemocytometer method. Data on mobile phone usage were obtained from call logs, and statistical analysis was performed using SPSS with a significance level of $p<0.05$.

Results

The study included mostly males (86%) aged 21-25 years (76%). Blood pressure analysis revealed that 47% had systolic BP >120 mmHg, and 51% had diastolic BP >80 mmHg. No significant correlation was found between mobile phone usage and blood pressure or leukocyte count ($p > 0.05$). Overall, mobile phone use showed minimal impact on cardiovascular and hematological parameters, including total leukocyte count and CRP levels, in young adults at IGIMS, Patna.

Conclusion

Prolonged mobile phone use showed a non-significant trend toward higher blood pressure, but no direct impact on leukocyte count. Further studies with larger samples are needed to explore potential health effects.

Recommendation

Future studies should involve a larger and more diverse population to enhance the validity of the findings. Long-term monitoring of mobile phone usage and its health effects should also be explored.

Keywords: *Mobile phone radiation, blood pressure, leukocyte count, cardiovascular effects, hematology.*
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Introduction

Mobile phones and other electronic devices have become essential components of contemporary existence [1]. The rapid improvements in mobile technology have led to a rise in the frequency of radiation emitted by these gadgets. Mobile phone radiation typically ranges from 900 MHz to 2.5 GHz [2]. With the global increase in mobile phone usage, apprehensions over its possible detrimental impacts have also emerged. Electromagnetic radiation from mobile phones has been linked to symptoms such as headaches, nausea, fatigue, dizziness, and memory loss, collectively referred to as "electromagnetic hypersensitivity" [3].

Electromagnetic radiation consists of photons, which possess a distinct amount of energy. Various forms of radiation exhibit differing energy levels contingent upon the photons they encompass. Electromagnetic waves produced by mobile phones may disrupt the operation of cardiac pacemakers and other implantable medical devices [4]. Furthermore, studies have shown that this ionizing radiation is harmful to DNA [5]. Ionizing radiation possesses significant energy capable of disrupting atomic and molecular bonds, resulting in ion

production. Conversely, non-ionizing radiation, including radio waves, microwaves, and infrared waves, lacks sufficient energy to ionize atoms or molecules [6]. Prolonged and frequent utilization of mobile phones may negatively impact bodily systems, especially the autonomic nervous system [7]. Mobile phones operate wirelessly via radio-frequency waves, and the electromagnetic radiation they emit can affect the autonomic, cardiovascular, endocrine, hematological, and reproductive systems [8]. This study seeks to assess the impact of mobile phone usage on cardiovascular and hematological parameters in young adults living at the Indira Gandhi Institute of Medical Science, Patna.

Methods

Study Design

This Cross-sectional study was conducted at the Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, over one year from May 2022 to April 2023. The research was carried out in the Department of General Medicine, Microbiology, and Hematology to assess the effects of mobile phone radiation on cardiovascular, inflammatory, and hematological parameters.

Study Setting

IGIMS is a premier tertiary care teaching hospital and research institute located in Patna, Bihar, India, known for providing advanced medical care and conducting multidisciplinary clinical research. The study was carried out in the Departments of General Medicine, Microbiology, and Hematology at IGIMS.

Study Population

Approximately 100 participants were recruited for the study. All subjects had been using mobile phones for at least the past five years. Inclusion criteria required participants to be healthy adults with no history of chronic illnesses or long-term medication use. Individuals with pre-existing cardiovascular, inflammatory, hematological, or neurological disorders were excluded from the study.

Study Procedure

Each participant underwent a detailed assessment, which included measuring blood pressure and inflammatory markers and conducting hematological evaluations.

- **Blood Pressure Measurement:** Blood pressure was recorded in a seated position using a mercury sphygmomanometer. To ensure accurate readings, each subject was given a five-minute rest period before the measurement. Three consecutive readings were taken at one-minute intervals, and the average value was considered for analysis.
- **Hematological Assessment:** A total white blood cell (WBC) count was performed using the hemocytometer method with Turk's fluid as the diluent. Blood samples were collected under aseptic conditions and analyzed manually using a compound microscope in the Department of Hematology at IGIMS, Patna.
- **C-Reactive Protein (CRP) Levels:** CRP levels were measured as an inflammatory biomarker. Blood samples were obtained under aseptic conditions and analyzed using a high-sensitivity CRP by photometric method. The analysis was performed in the Department of Microbiology at IGIMS, Patna, to determine systemic inflammation levels.
- **Assessment of Mobile Phone Usage:** The daily duration of mobile phone use was determined retrospectively from individual telephone billing records. Participants were asked to provide their call logs, and the total duration of calls was divided by the number of days to calculate the average daily usage. Additionally, the longest continuous duration of mobile phone use (in hours) was recorded for further analysis.

Bias

To reduce selection bias, participants were recruited consecutively from the outpatient population based on clear inclusion and exclusion criteria. Blood pressure measurements were standardized with a rest period and multiple readings to reduce measurement bias. Laboratory analyses were performed by trained personnel blinded to participants' mobile phone usage data to minimize observer bias. Recall bias was minimized by using objective call log data rather than self-reported phone use.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of Indira Gandhi Institute of Medical Sciences. Written informed consent was obtained from all participants before enrollment after explaining the study's purpose, procedures, and confidentiality assurance.

Statistical Analysis

The collected data were analyzed using the Statistical Package for the Social Sciences version 30 (SPSS 30) software. A chi-square test was performed to assess the relationship between mobile phone usage and cardiovascular and hematological parameters. A p-value of <0.05 was considered statistically significant.

Results

The demographic distribution of the study subjects showed that the majority (76%) belonged to the 21-25 years age group, followed by 14% in the 26-30 years category. The study had a higher proportion of male participants (86%) compared to females (14%). Regarding mobile phone usage, 51% of the subjects used their phones continuously for 2 hours, while 34% used them for 1 hour, and 15% for 3 hours, with no subjects exceeding 4 hours of continuous usage. These findings

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suggest that young adults, particularly males, exhibit higher mobile phone usage habits (Table 1).

Table 1: Demographic and Mobile Phone Usage Distribution

Category	Sub-category	No. of Subjects (n)	Percentage (%)
Age Group (Years)	<20	6	6.00
	21-25	76	76.00
	26-30	14	14.00
	31-35	4	4.00
Gender	Male	86	86.00
	Female	14	14.00
Continuous Mobile Usage (Hours)	≤1	34	34.00
	2	51	51.00
	3	15	15.00
	>4	0	0.00

The leukocyte count analysis revealed that 96% of subjects had a normal TLC range (4000-11000 Cumm), while 4% exhibited an elevated count (>11000 Cumm). Blood pressure analysis showed that 53% of subjects had systolic blood pressure between 100-120 mmHg, 37% fell within 121-140 mmHg, and 10% had systolic values exceeding 140 mmHg. Diastolic blood pressure distribution indicated that 49% of subjects had values between 70-80 mmHg, 48% between 81-90 mmHg, and 3% had diastolic readings above 90 mmHg. These results highlight that a small proportion of participants displayed hypertension-related concerns (Table 2).

Table 2: Blood Pressure and Leukocyte Count Distribution

Category	Sub-category	No. of Subjects (n)	Percentage (%)
Total Leukocyte Count (TLC) (Cumm)	<4000	0	0.00
	4000-11000	96	96.00
	>11000	4	4.00
Systolic Blood Pressure (mmHg)	100-120	53	53.00
	121-140	37	37.00
	>140	10	10.00
Diastolic Blood Pressure (mmHg)	70-80	49	49.00
	81-90	48	48.00
	>90	3	3.00
C-Reactive Protein (CRP) Levels (mg/L)	<1.0	65	65.00
	1.0-3.0	28	28.00
	>3.0	7	7.00

The relationship between continuous mobile phone usage and blood pressure revealed that among individuals using their phones for ≤1 hour, 30 had systolic BP within 100-120 mmHg, while 4 had values in the 121-140 mmHg range. In contrast, among those using their phones for 2-3 hours, 60 had systolic BP in the 100-120 mmHg range, and 7 had readings between 121-140 mmHg. Similarly, diastolic blood pressure analysis showed that among those using their phones for ≤1 hour, 19 had BP values in the 70-80 mmHg range, while 15 fell within 81-90 mmHg. Among individuals using phones for 2-3 hours, 30 had diastolic BP of 70-80 mmHg, while 33 had readings between 81-90 mmHg, with 3 showing diastolic BP >90 mmHg. Furthermore, the results indicate that 7% of participants had elevated CRP levels (>3.0 mg/L), suggesting potential systemic inflammation, while 65% had CRP levels below 1.0 mg/L, indicating a low inflammatory state. These findings indicate a potential trend of increased BP with prolonged mobile phone use. However, the chi-square test showed no significant association between mobile phone usage duration and systolic blood pressure (χ^2 = 0.04, p = 0.84) or diastolic blood pressure (χ^2 = 2.22, p = 0.33), indicating no statistically significant relationship between phone use and blood pressure levels. (Table 3).

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Table 3: Association of Continuous Mobile Usage with Systolic and Diastolic Blood Pressure

Duration (Hours)	Systolic BP (mmHg) 100-120	Systolic BP (mmHg) 121-140	Total No. of Subjects
≤1	30	4	34
2-3	60	7	67

Duration (Hours)	Diastolic BP (mmHg) 70-80	Diastolic BP (mmHg) 81-90	Diastolic BP (mmHg) >90	Total No. of Subjects
≤1	19	15	0	34
2-3	30	33	3	67

The association between mobile phone usage and leukocyte count showed that among individuals using their phones for ≤1 hour, 33 had a normal TLC (4000-11000 Cumm), while 1 had an elevated count (>11000 Cumm). Similarly, among those using phones for 2-3 hours, 63 had a normal TLC, while 3 exhibited an elevated count. The chi-square test did not show a significant correlation between mobile phone usage and leukocyte count, suggesting that phone use duration may not directly impact immune function as measured by TLC (Table 4).

Table 4: Association of Continuous Mobile Usage with Leukocyte Count

Duration (Hours)	TLC (Cumm) 4000-11000	TLC (Cumm) >11000	Total No. of Subjects
≤1	33	1	34
2-3	63	3	67

Discussion

This study aimed to evaluate the impact of mobile phone usage on physiological parameters, including blood pressure, CRP, and WBC count, among adults visiting IGIMS, Patna, residing at the university campus in Patna. The findings of the present study suggest that mobile phone usage does not have a statistically significant effect on WBC count. Most participants reported using their mobile phones continuously for approximately two hours daily. This limited duration of electromagnetic radiation exposure may not be sufficient to induce significant alterations in WBC levels. However, two subjects exhibited WBC counts above the normal range. Variability in WBC count could be influenced by individual differences in genetic predisposition, environmental factors, or variations in the type and intensity of mobile phone radiation, including thermal and non-thermal effects on blood cells [9].

While this study did not observe significant hematological alterations in mobile phone radiation, the present study's results align with earlier studies, which investigated the effects of electromagnetic radiation on WBC count in male albino rats [10], and those that examined the impact of low-frequency electromagnetic fields on hematological and immunological parameters in welders [11].

The relationship between mobile phone usage and hypertension is of particular concern, as hypertension is a major risk factor for cardiovascular diseases. The increasing use of mobile phones has raised questions regarding their potential adverse health effects. Since mobile phones are often held close to the head, numerous studies have explored their impact on the brain, particularly regarding cognitive functions and sleep disturbances. Some research has suggested that prolonged exposure to low-intensity electromagnetic fields (EMF) may be associated with an increased risk of cardiac arrhythmias, acute myocardial infarction, cardiovascular mortality, and disruptions in blood pressure regulation (Aghav et al., 2018) [12]. The present findings related to blood pressure parameters are consistent with previous studies that examined the environmental impact of mobile phone radiation on blood pressure [13] and those that investigated the non-thermal effects of mobile phone radiation on heart rate and blood pressure.

Conclusion

In this study, the majority of participants exhibited WBC counts within the normal physiological range, with only two individuals displaying elevated values. Similarly, most subjects had blood pressure (both systolic and diastolic) within normal limits, except for 21 individuals with elevated systolic BP and two with increased diastolic BP. Most patients also had CRP levels below 1.0 mg/L, indicating a low inflammatory state. These findings suggest that short-term mobile phone usage does not significantly alter hematological parameters. However, prolonged exposure to mobile phone radiation may contribute to autonomic nervous system imbalances, favoring increased sympathetic activity. Studies have reported that excessive mobile phone use may lead to a heightened sympathetic response and a reduced parasympathetic tone. This shift in autonomic regulation could have implications for cardiovascular health over time. While our study did not establish a direct causal link between mobile phone usage and significant physiological changes, long-term exposure to electromagnetic radiation warrants further investigation to determine its potential effects on health.

Generalizability

The study findings are primarily applicable to healthy young adults with similar mobile phone usage patterns

and may not extend to older populations or those with chronic illnesses. Further studies in diverse demographic groups are needed to confirm these results.

Limitations

This study's cross-sectional design and relatively small, male-dominant sample limit the ability to draw causal inferences and generalize findings. Additionally, other sources of electromagnetic exposure were not considered.

Recommendations

Future research should focus on larger, longitudinal studies across varied populations to better assess long-term effects. The inclusion of neurological and psychological assessments alongside cardiovascular and hematological parameters is recommended.

Acknowledgment

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List of Abbreviations

BP: Blood Pressure
CRP: C-Reactive Protein
IGIMS: Indira Gandhi Institute of Medical Sciences
TLC: Total Leukocyte Count
WBC: White Blood Cell
SPSS: Statistical Package for the Social Sciences.

Source of Funding

This study did not receive any external funding from governmental, commercial, or non-profit organizations.

Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

Author Contributions

All authors contributed equally to this study.

Data Availability

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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