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Original Research Article

Effects of Smartphone Use on Cardiovascular and Hematological Health in Adults

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Abstract:

Background: The widespread use of smartphones has significantly increased in recent years, raising concerns about their impact on human health. While the psychological effects of excessive smartphone use are well-documented, its influence on cardiovascular and hematological parameters remains underexplored.

Aim: To evaluate the effects of smartphone usage on cardiovascular (blood pressure, heart rate) and hematological (hemoglobin, RBC, WBC) parameters in healthy adults.

Methods: A cross-sectional study was conducted on 200 adults aged 18–45 years. Participants were categorized into three groups based on daily smartphone usage: low (<2 hours), moderate (2–4 hours), and high (>4 hours). Cardiovascular parameters were measured using a digital sphygmomanometer, and hematological indices were assessed via complete blood count. Data were analyzed using SPSS version 23.0, with ANOVA and Pearson correlation tests applied.

Results: High smartphone users exhibited significantly elevated systolic (127.6 ± 11.1 mmHg) and diastolic (81.4 ± 7.9 mmHg) blood pressure, as well as heart rate (83.1 ± 8.9 bpm), compared to low users. Hemoglobin and RBC counts were slightly reduced, while WBC counts were elevated in high users. Statistical analysis showed significant correlations between smartphone use and physiological parameters ($p < 0.05$).

Conclusion: Excessive smartphone usage is associated with increased cardiovascular activity and subtle changes in hematological profiles, indicating potential health risks with prolonged exposure.

Recommendations: Public health awareness campaigns should encourage responsible smartphone use and promote regular health monitoring, especially for individuals with high screen time. Further longitudinal research is recommended to establish causality and explore underlying mechanisms.

Keywords: Smartphone Usage, Blood Pressure, Hematological Parameters, Heart Rate, Screen Time.

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Introduction

The rapid proliferation of smartphones over the past decade has transformed the way individuals communicate, work, and entertain themselves. With over 6.9 billion smartphone users worldwide as of 2023, the device has become a near-ubiquitous aspect of modern life [1]. However, excessive smartphone usage has raised concerns about its potential impact on physical and psychological health. While much of the literature has focused on mental health issues such as anxiety, depression, and sleep disturbances [2], emerging research suggests that prolonged screen time may also have measurable physiological effects, particularly on cardiovascular and hematological systems.

Several studies have linked sedentary behavior—often associated with high screen time—to increased cardiovascular risk factors such as hypertension, elevated heart rate, and metabolic syndrome [3,4]. The frequent use of smartphones often leads to physical inactivity, poor posture, and stress, all of which may contribute to autonomic imbalance and sympathetic overactivity [5]. This autonomic dysregulation can result in elevated blood pressure and heart rate, both of which are established predictors of long-term cardiovascular morbidity [6].

Moreover, recent evidence suggests that chronic screen exposure may affect hematological parameters as well. Changes in hemoglobin concentration, red and white blood cell counts have been observed in populations exposed to high levels of electromagnetic radiation emitted by electronic devices, including smartphones [7]. Elevated white blood cell counts, for instance, may reflect low-grade inflammation or stress responses, which are known contributors to cardiovascular disease [8].

Young adults and working populations, in particular, are vulnerable due to their high dependence on

smartphones for work, communication, and entertainment. Despite the growing prevalence of excessive smartphone usage, limited studies have comprehensively assessed its combined impact on cardiovascular and hematological health. Most existing literature is either outdated or focused narrowly on one physiological system, thereby highlighting a critical gap in current knowledge.

Given these considerations, this study aims to evaluate the impact of smartphone usage on both cardiovascular parameters (blood pressure and heart rate) and hematological indices (hemoglobin, RBC, WBC counts) in healthy adults. Understanding these associations may help inform public health strategies and encourage more responsible smartphone usage.

Methodology

Study Design: This study was designed as a cross-sectional observational study.

Study Setting: The study was conducted at a tertiary care teaching hospital and associated outpatient clinics in Bihar. Data collection was carried out over a period of twelve months.

Participants: A total of 200 adult participants aged between 18 and 45 years were recruited for the study through convenient sampling. Participants were divided into groups based on self-reported smartphone usage (e.g., low, moderate, and high users). All participants provided written informed consent before being included in the study.

Inclusion criteria included adults aged 18–45 years who owned a smartphone and used it regularly for at least one year. Participants needed to be generally healthy and not on any medications that could alter cardiovascular or hematological parameters.

Exclusion criteria included individuals with a known history of cardiovascular disease, hematological disorders, diabetes mellitus, hypertension, or those who used wearable fitness devices that could influence their behavior. Pregnant individuals and those unwilling to consent were also excluded.

Bias: To minimize selection bias, participants were recruited from multiple clinics and departments. Information bias was reduced by using standardized and calibrated equipment for measurements. Recall bias was considered during self-reporting of smartphone usage; hence, participants were asked to provide average daily usage based on device settings or screen-time trackers when available.

Data Collection

Data were collected using a structured questionnaire and standardized clinical assessments. The questionnaire captured demographic details, average smartphone usage duration, and lifestyle factors. Cardiovascular parameters such as blood pressure and heart rate were recorded using a digital sphygmomanometer after a 10-minute rest. Blood samples were drawn for complete blood count (CBC) analysis using an automated hematology analyzer.

Procedure

Upon enrollment, each participant completed a pre-validated questionnaire. After resting, their blood pressure and heart rate were recorded three times at 5-minute intervals, and the average was used for analysis. Venous blood samples (5 mL) were collected under aseptic conditions and sent for CBC analysis on the same day. Participants were categorized based on daily smartphone usage into three groups: low (<2 hours), moderate (2–4 hours), and high (>4 hours).

Statistical Analysis

Data were entered and analyzed using **SPSS version 23.0**. Descriptive statistics were used to summarize participant characteristics. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Group comparisons were made using ANOVA or t-tests, depending on the number of groups and data distribution. Pearson's correlation coefficient was used to assess the relationship between smartphone usage and physiological parameters. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 200 adults participated in the study. The mean age was **29.8 ± 6.1 years**, with **55% (n=110)** males and **45% (n=90)** females. Based on self-reported average daily smartphone usage, participants were categorized into:

- **Low Usage (<2 hours/day)**: 60 participants (30%)
- **Moderate Usage (2–4 hours/day)**: 80 participants (40%)
- **High Usage (>4 hours/day)**: 60 participants (30%)

Table 1: Demographic Distribution of Participants

Variable	Low Users (n=60)	Moderate Users (n=80)	High Users (n=60)	Total (n=200)
Mean Age (years)	28.1 ± 5.9	29.9 ± 6.0	31.5 ± 6.2	29.8 ± 6.1
Males (%)	34 (56.7%)	45 (56.2%)	31 (51.7%)	110 (55%)
Females (%)	26 (43.3%)	35 (43.8%)	29 (48.3%)	90 (45%)

Age and gender were relatively evenly distributed across usage groups, minimizing demographic confounding.

Cardiovascular Parameters: Systolic and diastolic blood pressure, as well as heart rate, showed statistically significant differences between groups. High smartphone users had elevated values compared to low users.

Table 2: Cardiovascular Parameters Across Smartphone Usage Groups

Parameter	Low Users (n=60)	Moderate Users (n=80)	High Users (n=60)	p-value
Systolic BP (mmHg)	116.2 ± 9.3	121.5 ± 10.4	127.6 ± 11.1	<0.001 **
Diastolic BP (mmHg)	73.5 ± 6.7	77.2 ± 7.1	81.4 ± 7.9	<0.001 **
Heart Rate (bpm)	72.8 ± 7.2	77.4 ± 8.3	83.1 ± 8.9	<0.001 **

A clear trend of increasing blood pressure and heart rate was observed with higher smartphone usage. The differences were statistically significant ($p < 0.001$), suggesting a potential link between smartphone use and cardiovascular stress.

Hematological Parameters: Hematological indices, including hemoglobin (Hb), red blood cell (RBC) count, and white blood cell (WBC) count, also varied among groups.

Table 3: Hematological Parameters Across Smartphone Usage Groups

Parameter	Low Users (n=60)	Moderate Users (n=80)	High Users (n=60)	p-value
Hemoglobin (g/dL)	13.6 ± 1.1	13.4 ± 1.2	12.9 ± 1.4	0.004 *
RBC ($\times 10^6/\mu L$)	4.9 ± 0.3	4.8 ± 0.4	4.6 ± 0.4	0.007 *
WBC ($\times 10^3/\mu L$)	6.3 ± 1.2	6.7 ± 1.3	7.2 ± 1.5	0.002 *

Hemoglobin and RBC levels were slightly lower in high users, while WBC counts were higher, possibly indicating stress-related physiological changes. These findings were statistically significant.

Correlation Analysis: Pearson correlation analysis showed significant relationships between smartphone usage duration and several physiological parameters.

Table 4: Correlation Between Smartphone Usage and Physiological Parameters

Parameter	Pearson r	p-value
Systolic BP	0.42	<0.001 **
Diastolic BP	0.38	<0.001 **
Heart Rate	0.45	<0.001 **
Hemoglobin	-0.26	0.001 *
WBC Count	0.33	<0.001 **

There was a moderate positive correlation between smartphone usage and cardiovascular parameters and a negative correlation with hemoglobin levels. These suggest that prolonged use may be linked to increased physiological stress and possible systemic effects.

Statistical Summary

- All data were analyzed using **SPSS version 23.0**.
- ANOVA with post hoc Tukey tests revealed significant differences among groups.
- A p-value < 0.05 was considered statistically significant.
- Assumptions for parametric testing (normality and homogeneity of variance) were verified using Shapiro-Wilk and Levene's tests.

Discussion

The study included 200 adults categorized into low, moderate, and high smartphone usage groups. The demographic distribution was balanced, with a mean age of 29.8 years and a nearly equal gender ratio across all groups. This uniformity minimized the influence of demographic variables on the physiological outcomes measured.

Cardiovascular parameters—systolic blood pressure, diastolic blood pressure, and heart rate—showed a consistent and statistically significant increase with higher smartphone usage. Participants in the high-usage group (>4 hours/day) demonstrated notably higher systolic (127.6 mmHg) and diastolic (81.4 mmHg) blood pressures compared to low-usage individuals (<2 hours/day), who recorded 116.2 mmHg and 73.5 mmHg, respectively. Similarly, heart rate increased from 72.8 bpm in low users to 83.1 bpm in high users. These findings suggest a potential association between prolonged smartphone exposure and heightened cardiovascular activity, which may

reflect increased sympathetic nervous system stimulation or stress.

Hematological parameters revealed subtler but significant differences. Hemoglobin and RBC counts were slightly reduced in high smartphone users, while WBC counts were elevated. High users had a mean hemoglobin level of 12.9 g/dL compared to 13.6 g/dL in low users, and a WBC count of 7.2 $\times 10^3/\mu L$ versus 6.3 $\times 10^3/\mu L$ in the low-usage group. The decline in hemoglobin and RBCs, coupled with elevated WBCs, may point to underlying inflammatory or stress-related responses associated with excessive smartphone use, though further investigation would be necessary to confirm causality.

Correlation analysis supported these findings, with moderate positive correlations between smartphone usage and blood pressure, heart rate, and WBC count. A negative correlation was observed between smartphone use and hemoglobin levels. These relationships indicate that increased screen time is not just a behavioral habit but may have physiological implications, particularly on cardiovascular and immune-related functions.

Long-term monitoring of physical activity using smartphones has demonstrated significant cardiovascular benefits. In a large Japanese cohort study, higher average daily steps recorded by smartphones over a two-year period were associated with improvements in cardiovascular risk factors, including reduced weight, lower systolic blood pressure in men, improved HDL and triglyceride levels in both sexes, and decreased HbA1c levels in women, indicating that consistent physical activity tracking can positively influence metabolic and cardiovascular health [9].

User engagement with smartphone health apps has also shown promising effects. A systematic review of 24 studies revealed that increased interaction with cardiovascular health-related apps was significantly associated with reductions in weight, BMI, waist circumference, body fat percentage, and hemoglobin A1c. However, the effects on blood pressure and lipid profiles were less consistent, suggesting user engagement primarily supports lifestyle changes and glycemic control [10].

Gamification of health apps has emerged as a novel strategy to enhance user motivation and adherence. A systematic review highlighted that gamified apps improved lifestyle behaviors and metabolic outcomes such as physical activity and weight management among individuals at risk for cardiovascular disease. Despite high functionality ratings, engagement levels varied, emphasizing the need for more interactive and user-centric design to sustain behavioral change [11].

Innovative technologies have also enabled smartphones to directly assess hematological markers. Fu and Guo developed a smartphone-integrated electrochemical analyzer capable of accurately measuring total cholesterol through enzyme-based detection on disposable strips. This system was validated against clinical biochemical analyzers and shows potential for point-of-care cardiovascular risk screening [12]. Similarly, Wang et al. introduced a smartphone-based system to monitor triglyceride levels using a compact electrochemical sensor, demonstrating acceptable accuracy for use in early detection and management of cardiovascular risk factors [13].

A meta-analysis of 26 randomized controlled trials involving overweight and obese adults found that smartphone and wearable interventions significantly increased daily steps and moderate-to-vigorous physical activity, improved quality of life, and reduced body weight and BMI. However, no statistically significant changes were observed in blood pressure or heart rate, suggesting that while physical fitness and weight benefit from smartphone intervention, direct cardiovascular metrics may be less responsive [14].

Smartphone applications specifically designed for diabetes management were also found to impact cardiovascular risk. A systematic review and meta-analysis demonstrated that such apps were effective in reducing systolic blood pressure and triglyceride levels, although they did not significantly improve cholesterol or BMI levels. These findings underscore the secondary cardiovascular benefits of digital diabetes control interventions [15].

Furthermore, the use of smartphone sensors for cardiovascular diagnostics has shown early promise. A multiclass classifier leveraging smartphone accelerometers and gyroscopes was able to distinguish between normal sinus rhythm, atrial fibrillation, coronary artery disease, and other heart conditions using mechanocardiographic data, presenting a non-invasive, accessible method for cardiovascular screening [16].

Conclusion

This study found that excessive smartphone usage is associated with elevated blood pressure, increased heart rate, and altered hematological parameters in adults. High smartphone use may contribute to cardiovascular stress and potential inflammatory responses. These findings highlight the importance of monitoring screen time as part of maintaining overall health and well-being.

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