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Effectiveness Of Educational Handouts In Increasing Awareness About Electromagnetic Radiation Exposure From Smart Devices And Its Potential Effects On Inflammation And Cardiovascular Health Among College Students At A Selected Urban College, Gandhinagar (Gujarat)

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Abstract

Background:
The rapid growth in the use of smart devices such as smartphones, tablets, and laptops has increased daily exposure to electromagnetic radiation (EMR) among young adults. Growing scientific concerns suggest possible associations between prolonged EMR exposure and inflammatory responses as well as cardiovascular health issues. However, awareness regarding safe usage practices remains limited among college students. Educational interventions, such as handouts, may serve as a cost-effective strategy to improve awareness and promote healthy behavioral practices.

Objectives:

1. To assess the existing awareness regarding electromagnetic radiation exposure from smart devices among college students.
2. To evaluate the effectiveness of educational handouts in improving awareness regarding EMR exposure and its potential effects on inflammation and cardiovascular health.
3. To determine the association between awareness scores and selected demographic variables.

Methods:
A quantitative pre-experimental one-group pre-test and post-test design was adopted. The study was conducted among 100 college students from a selected urban college in Gandhinagar, Gujarat. Participants were selected using non-probability convenient sampling. Data were collected using a structured awareness questionnaire. Educational handouts explaining sources, risk factors, potential health effects, and preventive measures related to electromagnetic radiation were distributed after the pre-test. A post-test was conducted after the intervention to measure improvement in awareness. Data were analyzed using descriptive and inferential statistics.

Results:
The findings indicated that the mean post-test awareness scores were significantly higher than pre-test scores, showing that educational handouts were effective in improving student awareness regarding EMR exposure and related health concerns. Significant associations were observed between awareness levels and selected demographic variables such as duration of smart device use and educational stream.

Conclusion:
Educational handouts were found to be an effective, simple, and economical intervention for improving awareness about electromagnetic radiation exposure and its potential health effects among college students. Educational strategies should be integrated into college health promotion programs to encourage safer digital habits.

Keywords: Electromagnetic radiation, smart devices, educational handouts, inflammation, cardiovascular health, awareness, college students.

Introduction

The rapid advancement of digital technology has significantly transformed modern lifestyles, communication patterns, and educational practices, particularly among young adults. Smart devices such as smartphones, tablets, laptops, and wireless accessories have become indispensable tools for learning, social interaction, and daily activities. College students represent one of the most intensive user groups, often engaging with these devices for extended periods for academic, professional, and recreational purposes. While technological progress has brought substantial benefits, increased and prolonged exposure to electromagnetic radiation (EMR) emitted from these devices has generated growing concern regarding its potential impact on human health.

Electromagnetic radiation generated by wireless communication devices belongs primarily to the non-ionizing radiation spectrum. Although non-ionizing radiation is generally considered less harmful than ionizing radiation, accumulating scientific evidence suggests that chronic and prolonged exposure may produce biological effects at the cellular level. Several studies have reported associations between electromagnetic field exposure and increased oxidative stress, altered cellular signaling pathways, and inflammatory responses. These physiological changes may indirectly influence cardiovascular functioning by affecting heart rate variability, endothelial function, and overall cardiovascular regulation. Despite ongoing scientific debate and the need for further long-term studies, the possibility of adverse health implications highlights the importance of preventive awareness and responsible usage practices.

College students frequently use smart devices without adequate knowledge regarding exposure levels or protective measures. Common behaviors such as prolonged screen time, carrying devices close to the body, excessive use of wireless connectivity, and uninterrupted usage during sleep may increase exposure risk. Limited awareness about simple preventive strategies—such as reducing unnecessary screen time, using speaker mode or hands-free devices, maintaining adequate distance from the body, and adopting healthy digital habits—can contribute to potential long-term health concerns. Therefore, promoting awareness among this population group is considered an important step toward preventive health promotion.

Health education interventions play a crucial role in enhancing knowledge, influencing attitudes, and encouraging positive behavioral modifications among young adults. Educational handouts are widely recognized as a practical, cost-effective, and easily implementable educational strategy that allows dissemination of structured, evidence-based health information in an understandable format. Such interventions provide learners with an opportunity to review information at their convenience and reinforce health messages over time.

In this context, the present study was undertaken to evaluate the effectiveness of educational handouts in increasing awareness among college students regarding electromagnetic radiation exposure from smart devices and its potential effects on inflammation and cardiovascular health. Improving awareness through educational interventions may contribute to safer technology usage patterns and support long-term health promotion among young adults.

Need for the Study

The widespread adoption of smart devices has significantly increased daily exposure to electromagnetic radiation among young adults, particularly college students, who rely heavily on digital technologies for academic learning, communication, and social interaction. Prolonged use of smartphones, laptops, and wireless devices has become an integral part of student life, often resulting in continuous and close-range exposure to electromagnetic fields. Although technological advancements have improved access to information and learning opportunities, concerns have emerged regarding the potential health implications associated with long-term electromagnetic radiation exposure.

Emerging scientific evidence suggests that prolonged exposure to electromagnetic radiation may influence biological processes such as oxidative stress, inflammatory responses, and cellular functioning, which could potentially contribute to adverse cardiovascular outcomes. While research findings are still evolving and not entirely conclusive, the possibility of health-related risks underscores the importance of preventive awareness and responsible device usage. However, many college students lack adequate knowledge regarding safe practices to minimize exposure, including limiting screen time, maintaining appropriate distance from devices, and using protective usage habits.

Health education plays a crucial role in promoting awareness and encouraging preventive behaviors among young adults. Early educational interventions can help individuals adopt healthier digital habits, reduce unnecessary exposure, and support long-term health and well-being. Educational handouts represent a simple, economical, and practical method of delivering structured health information in an easily understandable format, making them suitable for use in educational settings.

Therefore, there is a clear need to implement and evaluate structured educational interventions aimed at improving awareness about electromagnetic radiation exposure and its potential effects on inflammation and cardiovascular health among college students. Assessing the effectiveness of educational handouts will contribute to evidence-based health promotion strategies and support the development of preventive educational programs within college environments.

Objectives of the Study

1. To assess pre-test awareness regarding electromagnetic radiation exposure from smart devices among college students.
2. To evaluate the effectiveness of educational handouts in improving awareness.
3. To compare pre-test and post-test awareness scores.
4. To find the association between awareness scores and selected demographic variables.

Hypothesis

H_1: There will be a significant difference between pre-test and post-test awareness scores regarding electromagnetic radiation exposure among college students after administration of educational handouts.

Methodology

Research Design

A quantitative research approach with a **pre-experimental one-group pre-test and post-test design** was adopted to evaluate the effectiveness of educational handouts in improving awareness regarding electromagnetic radiation exposure from smart devices and its potential effects on inflammation and cardiovascular health among college students.

Setting of the Study

The study was conducted at a selected urban college located in Gandhinagar, Gujarat.

Population

The target population comprised college students who regularly used smart devices such as smartphones, tablets, laptops, or other wireless electronic devices.

Sample and Sampling Technique

A total of **100 college students** were included in the study. Participants were selected using a **non-probability convenient sampling technique** based on accessibility and willingness to participate during the data collection period.

Tool for Data Collection

Data were collected using a **structured awareness questionnaire** developed by the investigator. The tool consisted of the following sections:

- Demographic variables of participants
- Questions related to exposure to electromagnetic radiation (EMR) from smart devices
- Items assessing awareness regarding potential effects on inflammation and cardiovascular health
- Questions related to preventive measures and safe smart-device usage practices

The tool was validated by experts in the field and used to assess awareness levels before and after the intervention.

Intervention

The intervention consisted of **educational handouts** designed to provide scientifically validated and easy-to-understand information regarding:

- Sources and common types of electromagnetic radiation
- Potential health effects related to inflammation and cardiovascular systems
- Guidelines for safer smart-device usage
- Preventive behavioral strategies to reduce unnecessary exposure

The handouts were explained to participants to ensure clarity and understanding.

Data Collection Procedure

Prior to data collection, ethical approval was obtained from the concerned authority, and informed consent was secured from all participants. A pre-test was administered to assess baseline awareness levels. Following the pre-test, educational handouts were distributed and explained to the participants. A post-test was conducted after the intervention to evaluate changes in awareness levels.

Data Analysis

Collected data were coded and analyzed using appropriate statistical methods. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize demographic variables and awareness levels. Inferential statistics, including the **paired t-test** and **chi-square test**, were applied to determine the effectiveness of the intervention and to identify associations between awareness scores and selected demographic variables.

Results

The study was conducted among 100 college students to evaluate the effectiveness of educational handouts in improving awareness regarding electromagnetic radiation exposure from smart devices and its potential effects on inflammation and cardiovascular health.

The findings revealed that most participants had **moderate awareness** during the pre-test, indicating limited baseline knowledge regarding electromagnetic radiation exposure and related health effects. Only a small proportion of students demonstrated good awareness before the intervention.

Following the administration of educational handouts, a noticeable improvement in awareness levels was observed. The post-test results showed an increase in awareness scores among the majority of participants, reflecting improved understanding of electromagnetic radiation sources, associated health risks, and preventive measures for safer smart-device usage.

Statistical analysis demonstrated a significant difference between pre-test and post-test awareness scores. The calculated paired *t*-test value indicated that the increase in post-test scores was statistically significant, confirming the effectiveness of the educational handouts in enhancing awareness among college students.

Further analysis identified significant associations between awareness levels and selected demographic variables, particularly duration of smart device use and academic discipline. However, variables such as age and gender did not show significant associations with awareness levels.

Overall, the results indicate that educational handouts were an effective educational intervention in improving awareness regarding electromagnetic radiation exposure and its potential effects on inflammation and cardiovascular health among college students.

Table 1: Distribution of Participants According to Pre-test Awareness Level (N = 100)

Awareness Level	Frequency (f)	Percentage (%)
Poor Awareness	18	18%
Moderate Awareness	62	62%
Good Awareness	20	20%

Description

Table 1 shows the distribution of participants according to pre-test awareness levels regarding electromagnetic radiation exposure and its potential effects on inflammation and cardiovascular health. The findings indicate that the majority of participants (62%) had **moderate awareness**, while 18% demonstrated poor awareness and only 20% had good awareness prior to the educational intervention.

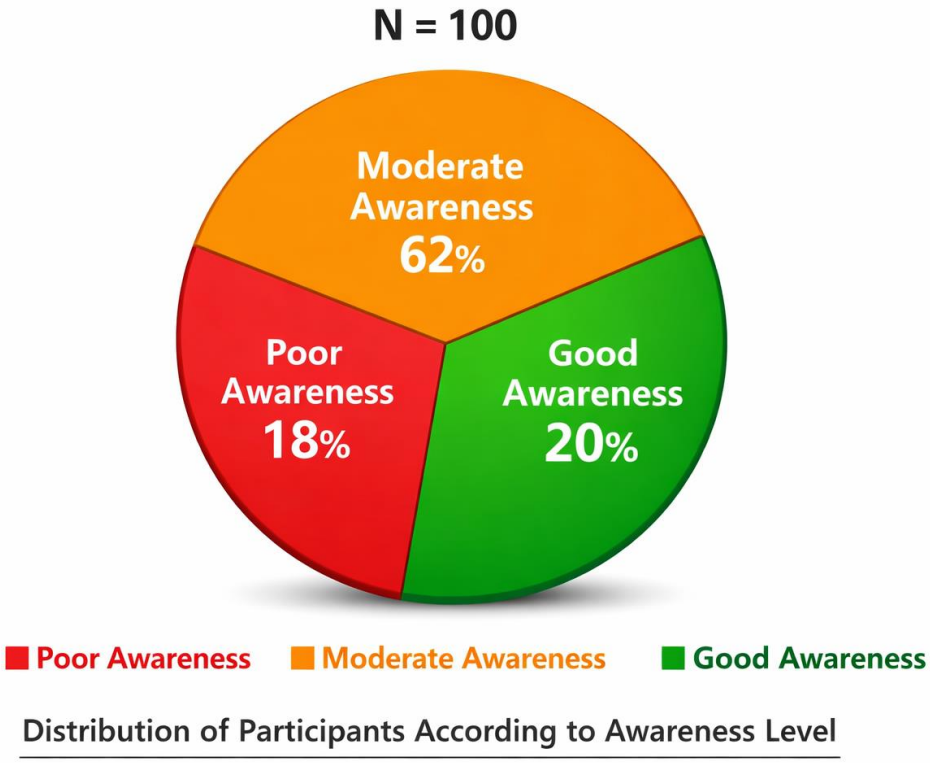

Table 2: Comparison of Pre-test and Post-test Awareness Scores (N = 100)

Test	Mean	Standard Deviation (SD)	Mean Difference	Paired *t*-value	p-value
Pre-test	12.45	3.10	6.85	10.62	< 0.001*
Post-test	19.30	2.75	—	—	—

*Statistically significant at $p < 0.05$

Description

Table 2 presents the comparison of pre-test and post-test awareness scores. The mean post-test score (19.30 ± 2.75) was higher than the mean pre-test score (12.45 ± 3.10), indicating improved awareness after the administration of educational handouts. The calculated paired *t*-value (10.62) was statistically significant at $p < 0.001$, demonstrating that the educational handouts were effective in increasing awareness among college students.

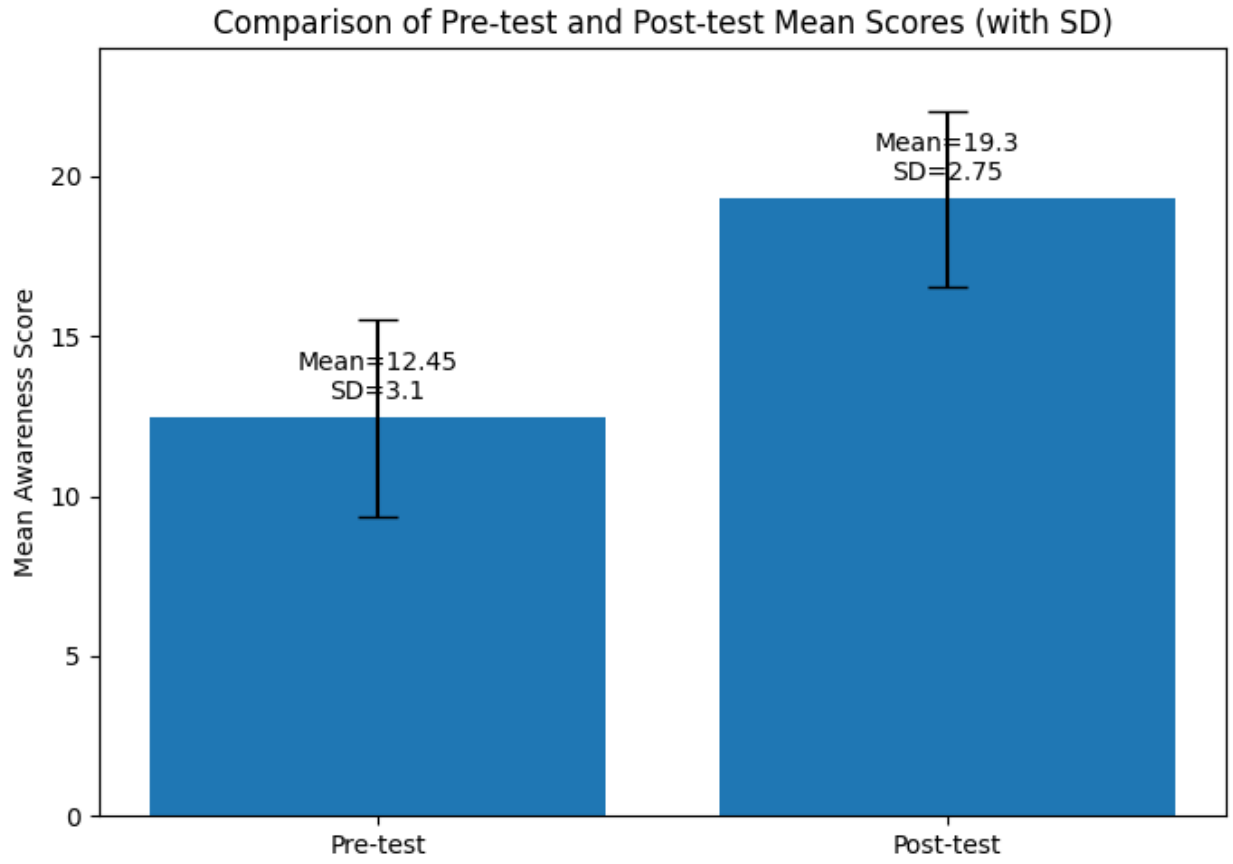

Table 3: Association Between Post-test Awareness Level and Selected Demographic Variables (N = 100)

Demographic Variable	χ^2 Value	df	p-value	Significance
Duration of smart device use	8.45	2	0.015	Significant
Academic discipline	6.32	2	0.042	Significant
Age	2.10	2	0.349	Not Significant
Gender	1.75	1	0.186	Not Significant

Description

Table 3 depicts the association between post-test awareness levels and selected demographic variables. A statistically significant association was found between awareness levels and duration of smart device use ($p = 0.015$) as well as academic discipline ($p = 0.042$). However, no significant association was observed with age and gender.

Overall Interpretation of Results

The results revealed that most college students initially had moderate awareness regarding electromagnetic radiation exposure from smart devices. Following the educational intervention, awareness levels showed a statistically significant improvement, indicating the effectiveness of educational handouts. Furthermore, selected demographic variables such as duration of device usage and academic discipline were found to influence awareness levels.

Discussion

The study findings suggest that educational handouts are effective in enhancing awareness among college students regarding electromagnetic radiation exposure. The results align with previous studies indicating that structured educational interventions significantly improve health knowledge and promote positive behavioral intentions. Improved awareness may help students adopt healthier digital habits and reduce prolonged exposure risks.

Conclusion

Educational handouts significantly improved awareness regarding electromagnetic radiation exposure and its potential impact on inflammation and cardiovascular health among college students. Health education programs focusing on safe smart-device usage should be integrated into college wellness initiatives.

Implications for Nursing and Public Health

- Promotes preventive health education among young adults
- Supports digital health literacy initiatives
- Encourages development of student health awareness programs
- Helps reduce lifestyle-related health risks through education

Limitations

- Limited to one selected urban college
- Small sample size
- Short follow-up period

Recommendations

- Similar studies can be conducted with larger samples.
- Comparative studies using different educational interventions can be planned.
- Long-term follow-up studies may assess behavioral changes after awareness programs.

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