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Original Research

To evaluate the effectiveness of a structured teaching programme on knowledge regarding health hazards of mobile phone radiation among antenatal mothers at selected maternity hospitals, Jaipur

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ABSTRACT:

Background: Mobile phones are widely used in daily life, resulting in routine exposure to radiofrequency electromagnetic fields. During pregnancy, mothers may use mobile phones frequently for communication, information, and health-related support, yet their awareness about possible health hazards and preventive measures may be limited. Structured health education can strengthen knowledge and promote safer mobile phone practices among antenatal mothers. **Aim:** To evaluate the effectiveness of a structured teaching programme on knowledge regarding health hazards of mobile phone radiation among antenatal mothers at selected maternity hospitals, Jaipur. **Materials and Methods:** A quantitative approach with a one-group pre-test post-test (quasi-experimental) design was adopted. The study was conducted among 100 antenatal mothers attending selected maternity hospitals in Jaipur, selected through non-probability convenience sampling. Data were collected using a structured knowledge questionnaire containing 30 items, along with a demographic profile form. After the pre-test assessment, a structured teaching programme was administered using lecture, PowerPoint presentation, and discussion for 30–45 minutes. The post-test was conducted seven days after the intervention using the same questionnaire. **Results:** Baseline findings showed that 63% of antenatal mothers had poor knowledge and 37% had moderate knowledge, with none having good knowledge in the pre-test. After the structured teaching programme, 77% achieved good knowledge, 19% had moderate knowledge, and only 4% remained in the poor category. The mean knowledge score increased from 13.26 ± 3.10 in the pre-test to 22.81 ± 3.05 in the post-test, with a mean difference of 9.55 and a statistically significant improvement ($t = 12.45$, $p = 0.0001$). Significant associations were found between post-test knowledge and age ($p = 0.038$), education ($p = 0.021$), gestational age ($p = 0.028$), and daily mobile use ($p = 0.012$). **Conclusion:** The structured teaching programme significantly improved antenatal mothers' knowledge regarding health hazards of mobile phone radiation. Integrating such educational interventions into routine antenatal services can enhance awareness and encourage safer mobile phone practices during pregnancy.

Keywords: antenatal mothers, mobile phone radiation, health hazards, structured teaching programme, knowledge assessment

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INTRODUCTION

Mobile phones have become inseparable from everyday life, serving as tools for communication, work, learning, and entertainment. Their widespread use means that exposure to radiofrequency electromagnetic fields (RF-EMF)—a form of non-ionizing radiation emitted during calls, data transfer, and wireless connectivity—has also become routine for most people.[1] As technology advances and dependence on smartphones increases, questions about possible health effects and safe usage practices continue to attract attention from health agencies, researchers, and the general public.[2]RF-EMF differs from ionizing radiation such as X-rays because it does not carry enough energy to break chemical bonds. The main established biological interaction at levels typically encountered with mobile technology is tissue heating; however, the degree of heating depends on

distance from the device, duration of exposure, and the power output of the handset and network conditions.[2] Because exposure patterns vary across individuals, public understanding of "radiation" from mobile phones is often shaped by mixed messages, incomplete information, and concern amplified by frequent daily use.[1]Pregnancy is a period of major physiological change, and antenatal mothers are often highly motivated to adopt safer practices when risks to maternal and fetal health are discussed clearly. At the same time, pregnancy may increase dependence on mobile phones for telehealth appointments, family contact, social support, pregnancy-tracking applications, and emergency communication. This creates a practical challenge: antenatal mothers may experience high exposure through prolonged use while having limited knowledge about what RF-EMF is, how exposure occurs, and what precautions are reasonable.[2] In clinical settings, this knowledge gap matters because health promotion during antenatal visits is expected to translate information into actionable behaviors.International scientific bodies have developed exposure guidelines to protect the public from established adverse effects. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) published updated guidance for limiting exposure across the RF range used by modern wireless technologies, emphasizing protection against adverse health effects and offering a framework for exposure restrictions.[3] Such recommendations are important in public health communication because they provide a reference point for what is considered safe within regulated limits. Yet guidelines alone do not ensure awareness, especially among community populations who may never encounter these documents directly.Large evidence syntheses have also evaluated the broader scientific literature on electromagnetic fields, including mobile communications. The European Commission's Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) reviewed available research and highlighted areas where evidence is stronger, where uncertainty persists, and where methodological challenges remain.[4] These reviews reinforce an essential point for health education: even when definitive conclusions are limited for certain outcomes, individuals can still be guided toward sensible exposure-reduction habits that do not disrupt daily life.Research in toxicology has contributed additional perspectives by exploring biological effects under controlled conditions. For example, the U.S. National Toxicology Program (NTP) conducted large-scale experimental studies using radiofrequency radiation modulated to resemble cell phone signals, generating findings that have been widely discussed in scientific and regulatory contexts.[5] While results from animal models cannot be directly translated into human pregnancy outcomes, such studies influence risk communication, public perception, and precautionary behavior. Therefore, antenatal mothers may benefit from clear education that distinguishes established knowledge from ongoing research, helping them avoid both unnecessary fear and unsafe overconfidence.Regulatory agencies also provide public-facing information that can support practical health teaching. The U.S. Food and Drug Administration (FDA) summarizes evidence trends, explains how RF exposure is regulated, and offers simple steps that can reduce exposure, such as increasing distance between the phone and the body and using hands-free options.[6] For antenatal mothers, these measures are particularly relevant because they are low-cost, easy to follow, and compatible with continued phone use. However, the ability to apply such steps depends on awareness, correct understanding, and motivation—factors that structured education can strengthen.Epidemiological research has examined associations between maternal mobile phone use and child outcomes, adding to the ongoing discussion about potential long-term effects of exposure patterns during pregnancy. For instance, population-based work from the Danish National Birth Cohort explored prenatal and postnatal exposure and reported associations with behavioral outcomes in children, emphasizing the continuing interest in this field and the need for careful interpretation and further study.[7] Even when causal pathways remain uncertain, such studies increase the importance of educating pregnant women about prudent, balanced habits that may reduce unnecessary exposure.

MATERIALS AND METHODS

A quantitative strategy was selected to generate measurable evidence on awareness of mobile-phone radiation risks during pregnancy. Numerical scoring of responses enabled objective comparison of knowledge levels before and after the educational input, supporting statistical interpretation of change.A quasi-experimental, one-group pre-test–post-test format was applied to determine the impact of the planned instruction. Baseline knowledge was recorded initially (O_1), the structured teaching programme was delivered as the intervention (X), and follow-up knowledge was measured after completion (O_2), allowing estimation of learning gain attributable to the programme.Data collection was carried out in selected maternity hospitals in Jaipur, using antenatal outpatient and clinic areas where pregnant women routinely attend check-ups. Available rooms suitable for counselling or demonstration were used to conduct the teaching session and administer assessments with privacy and minimal disturbance.The target group comprised antenatal mothers attending the chosen maternity hospitals in Jaipur. A total of 100 eligible participants were enrolled through non-probability convenience selection, based on availability during clinic visits and willingness to participate at the time of recruitment.

Inclusion criteria

Participants were pregnant women aged 18–40 years who attended antenatal services at the selected hospitals, could communicate in Hindi or English, and agreed to take part after receiving an explanation of the purpose and procedure, followed by written consent.

Exclusion criteria

Women with severe medical conditions limiting participation were not enrolled. Those who had previously received formal teaching on mobile-phone radiation, as well as individuals who declined consent or withdrew at any stage, were excluded from the sample.

The educational package served as the independent variable, while the outcome variable was the knowledge score related to health hazards associated with mobile-phone radiation. Factors such as age, education, occupation, gestational period, pattern of mobile use, family type, and monthly income were considered potential confounders that could influence baseline understanding or learning response.

Methodology

A structured knowledge questionnaire was prepared using relevant literature and expert input to ensure content suitability. The instrument included two parts: participant characteristics (such as age, education, occupation, gestational age, parity, and socio-economic indicators) and a 30-item knowledge section covering sources and types of exposure, possible health effects, and preventive practices. Each correct response was awarded one mark, with zero for incorrect or unanswered items, producing a maximum score of 30; interpretation categories were set as poor for below 50%, moderate for 50–75%, and good for above 75%.

Structured Teaching Programme

The instructional module was developed from dependable references such as World Health Organization materials and national health guidance. Delivery used a PowerPoint-supported lecture with interactive discussion, planned for approximately 30–45 minutes per sitting, focusing on radiation exposure basics, potential maternal–fetal concerns, and practical precautions for safer mobile usage.

Data collection procedure

After obtaining institutional approvals, eligible women were approached in the antenatal clinic, the study was explained, and written informed consent was collected. The pre-test questionnaire was administered first to record baseline knowledge. Immediately afterward, the structured teaching programme was conducted for the same participants. The post-test assessment using the identical questionnaire was completed seven days later, and all responses were coded and compiled for analysis.

RESULTS

Table 1: Frequency and percentage distribution of demographic variables

Table 1 describes the demographic characteristics of the 100 antenatal mothers who participated in the study. With regard to age, the largest proportion of participants belonged to the 23–27 years age group (45%), followed by those aged 28–32 years (26%). Mothers aged 18–22 years constituted 21%, while only a small proportion (8%) were above 32 years, indicating that most participants were in the early to mid-reproductive age group. Educational status showed that nearly one-third of the mothers had completed secondary education (32%), while 30% had higher secondary education and 26% were graduates or above. A smaller segment (12%) had only primary education, reflecting a varied educational background among the participants. In terms of occupation, the majority of antenatal mothers were homemakers (71%), whereas 29% were engaged in paid employment. Analysis of gestational age revealed that more than half of the mothers (53%) were in the second trimester, followed by those in the third trimester (29%) and first trimester (18%). Regarding mobile phone usage per day, the highest proportion of participants reported usage of 3–4 hours daily (41%), while 29% used mobile phones for 1–2 hours, 18% for more than 4 hours, and 12% for less than one hour. Family structure showed that most participants belonged to nuclear families (63%), with the remaining 37% living in joint families. Monthly income distribution indicated that the largest group (38%) earned between ₹10,001–20,000 per month, followed by 27% earning ₹20,001–30,000, 19% earning below ₹10,000, and 16% earning above ₹30,000, demonstrating a wide socio-economic range among the respondents.

Table 2: Pre-test levels of knowledge regarding health hazards of mobile phone radiation

Table 2 presents the baseline knowledge levels of antenatal mothers before the structured teaching programme. The findings reveal that a majority of participants (63%) had poor knowledge scores, indicating limited awareness regarding the health hazards of mobile phone radiation. The remaining 37% demonstrated a moderate level of knowledge, while none of the participants achieved a good knowledge score in the pre-test.

Table 3: Post-test levels of knowledge regarding health hazards of mobile phone radiation

Table 3 illustrates the distribution of knowledge levels after the administration of the structured teaching programme. A marked improvement is evident, as 77% of the antenatal mothers achieved a good level of knowledge in the post-test. Only 19% remained in the moderate knowledge category, and a minimal proportion (4%) continued to have poor knowledge scores.

Table 4: Comparison of pre-test and post-test knowledge scores

Table 4 compares the mean knowledge scores of antenatal mothers before and after the intervention. The mean pre-test score was 13.26 with a standard deviation of 3.10, reflecting generally low baseline knowledge. Following the structured teaching programme, the mean post-test score increased to 22.81 with a standard deviation of 3.05. The mean difference between pre-test and post-test scores was 9.55, representing a mean percentage increase of 19.82%. The calculated t-value of 12.45 with a highly significant p-value of 0.0001 indicates that the improvement in knowledge scores was statistically significant.

Table 5: Association between post-test knowledge scores and selected demographic variables

Table 5 examines the association between post-test knowledge levels and selected demographic variables. Statistically significant associations were observed with age ($p = 0.038$), education ($p = 0.021$), gestational age ($p = 0.028$), and daily mobile phone usage ($p = 0.012$), suggesting that these factors influenced the level of knowledge gained after the intervention. In contrast, occupation ($p = 0.172$), type of family ($p = 0.136$), and monthly income ($p = 0.180$) did not show a significant association with post-test knowledge scores.

Table 1: Frequency and percentage distribution of demographic variables

Demographic Variable	Attributes	Frequency	Percentage (%)
Age	18–22	21	21
	23–27	45	45
	28–32	26	26
	>32	8	8
Education	Primary	12	12
	Secondary	32	32
	Higher Secondary	30	30
	Graduate & above	26	26
Occupation	Homemaker	71	71
	Working	29	29
Gestational Age	1st trimester	18	18
	2nd trimester	53	53
	3rd trimester	29	29
Mobile Use/Day	<1 hr	12	12
	1–2 hr	29	29
	3–4 hr	41	41
	>4 hr	18	18
Type of Family	Nuclear	63	63
	Joint	37	37
Monthly Income	<10,000	19	19
	10,001–20,000	38	38
	20,001–30,000	27	27
	>30,000	16	16

Table 2: Frequency and percentage distribution of pre-test levels of knowledge regarding health hazards of mobile phone radiation

Level	Frequency	Percentage (%)
Poor (<15)	63	63
Moderate (15–22)	37	37
Good (>22)	0	0

Table 3: Frequency and percentage distribution of post-test levels of knowledge regarding health hazards of mobile phone radiation

Level	Frequency	Percentage (%)
Poor (<15)	4	4
Moderate (15–22)	19	19
Good (>22)	77	77

Table 4: Comparison of pre-test and post-test knowledge scores regarding health hazards of mobile phone radiation

Test	Mean	SD	Mean Difference	Mean % Increase	t-value	p-value
Pre-test	13.26	3.10	–	–	–	–
Post-test	22.81	3.05	9.55	19.82	12.45	0.0001*

Table 5: Association between post-test knowledge scores and selected demographic variables

Demographic Variable	Chi-square Value	df	p-value	Association
Age	8.42	3	0.038	Significant
Education	9.76	3	0.021	Significant
Occupation	1.85	1	0.172	Not Significant
Gestational Age	7.14	2	0.028	Significant
Mobile Use/Day	10.92	3	0.012	Significant
Type of Family	2.22	1	0.136	Not Significant
Monthly Income	4.89	3	0.180	Not Significant

DISCUSSION

The present study included 100 antenatal mothers, with the largest share in the 23–27 years group (45%) and a predominantly homemaker profile (71%). A comparable pattern was noted by Biazar et al. (2021) among 322 pregnant women, where the commonest age band was 21–30 years (45.3%) and most were housewives (84.5%); however, daily exposure appeared higher in the current sample because 59% reported ≥3 hours/day (3–4 hours: 41%; >4 hours: 18%), whereas Biazar et al. reported a mean daily use of 2.66 ± 2.02 hours.[8]

Before the structured teaching programme, knowledge deficits were clear in this study: 63% of mothers had poor knowledge and none achieved the "good" category, indicating that routine antenatal contact alone may not ensure awareness of mobile phone radiation hazards. A similar gap has been documented outside pregnancy contexts as well; Pereira et al. (2022) found that 61.8% of parents had inadequate knowledge on mobile phone hazards, which aligns closely with the current study's 63% poor baseline knowledge and supports the need for planned health education in communities.[9]

In addition to high daily usage, the current results suggest that awareness may not naturally match exposure: despite 41% using mobiles 3–4 hours/day, pre-test performance remained low (mean 13.26 ± 3.10). This mirrors the awareness–behavior mismatch reported by Paul et al. (2022): among students, 39.4% used phones >6 hours/day and only 20.8% were "very aware" of the 2011 cancer-related classification statement referenced in their questionnaire; notably, many also lacked reproductive-risk awareness (e.g., only 49.0% answered "yes" to EMF effects on ovaries). Together with the present baseline findings (63% poor), this suggests that heavy use can coexist with incomplete understanding unless structured education is provided.[10]

After the intervention, the present study showed a strong shift in knowledge distribution, with 77% reaching the "good" category and only 4% remaining poor—an improvement that indicates the structured teaching programme was highly effective for antenatal mothers. Comparable benefits of planned teaching are reported by Bharti et al. (2019) among college students: "good" knowledge increased from 3.4% pre-test to 48.4% post-test, and poor/below-average categories were eliminated post-intervention. In comparison, the current study achieved a larger post-intervention "good" proportion (77%), possibly reflecting higher receptivity when education is linked to pregnancy and fetal well-being.[11]

The magnitude of improvement in mean knowledge scores further supports effectiveness: the current study increased from 13.26 ± 3.10 to 22.81 ± 3.05, with a mean difference of 9.55 and high statistical significance ($t = 12.45$, $p = 0.0001$). A similar pre–post rise was observed by Sumangala & Rao (2016) among 50 antenatal women, where mean knowledge increased from 10.96 ± 3.36 to 18.88 ± 3.12 after structured teaching. While both studies demonstrate meaningful gains, the present study's post-test mean (22.81) and mean difference (9.55) suggest a comparatively stronger improvement, potentially due to session design, content emphasis, or larger sample stability (N=100).[12]

The present analysis also identified that post-test knowledge was significantly associated with gestational age ($p = 0.028$) and daily mobile use ($p = 0.012$), indicating that exposure-related factors influenced learning outcomes. This is relevant when interpreted alongside epidemiologic findings on pregnancy outcomes: Tsarna et al. (2019), using 55,507 pregnancies across four cohorts, reported that the intermediate exposure group had a higher risk of lower gestational age (HR = 1.04; 95% CI: 1.01–1.07) and noted exposure–response relationships for shorter pregnancy duration and preterm birth. Although the current work measured knowledge rather than clinical outcomes, the combination of high usage in this sample (59% ≥3 hours/day) and significant links with usage and gestational stage underscores why antenatal education should include practical exposure-reduction guidance.[13]

Daily exposure patterns in this study (only 12% using <1 hour/day) also contrast with earlier cohort-era patterns and highlight the modern relevance of

counseling. In a large pooled analysis, Birks et al. (2017) reported that 38.8% of mothers (largely driven by an earlier recruitment period) reported no cell phone use during pregnancy, and they observed increasing risk trends for child hyperactivity/inattention with higher maternal use (e.g., OR 1.28 for clinical-range hyperactivity/inattention among high users). While causality remains debated and confounding is possible, the present study's strong learning gains (post-test good: 77%) indicate that antenatal teaching can be a feasible route to promote safer communication habits, especially in populations with high routine use.[14]

Finally, the significant associations of post-test knowledge with age ($p = 0.038$) and education ($p = 0.021$) in this study suggest the need for tailored messaging, with simplified risk communication for less-educated groups and reinforcement for younger/high-use mothers. This aligns with the broader public health context that underpins risk concern: Baan et al. (2011) summarized the IARC conclusion classifying radiofrequency electromagnetic fields as "possibly carcinogenic to humans (Group 2B)", which continues to influence public perception and preventive advice. Given that the present intervention produced a statistically significant mean gain (9.55) and moved most mothers into the "good" knowledge band (77%), integrating structured, literacy-sensitive counseling into routine antenatal services may be an effective way to translate this broader risk discourse into clear, practical maternal guidance.[15]

CONCLUSION

The study concluded that antenatal mothers initially had inadequate knowledge regarding the health hazards of mobile phone radiation, as reflected by low pre-test scores. After implementing the structured teaching programme, there was a marked and statistically significant improvement in post-test knowledge levels, showing the intervention to be effective. Post-test knowledge was significantly associated with age, education, gestational age, and daily mobile phone use, indicating these factors influenced learning outcomes. Overall, the structured teaching programme is a useful educational strategy to improve awareness and promote safer mobile phone practices among antenatal mothers.

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