

## The Cytological Effects of Mobile Phone Radiation on Buccal Mucosa of Students of a Dental College in Chengalpattu District in Tamil Nadu

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### ABSTRACT:

The developing technology resulting in easier availability of smart phones resulting in prolonged usage by all ages of human race resulting in radiation effects that can potentially lead to risk factors with especially in people talking for long hours at night. The present study is to evaluate the cytological effects of prolonged mobile phone usage on the Buccal mucosa of students of Karpaga Vinayaga Institute of Dental Sciences. To assess duration of usage of mobile phones, to detect the cytological changes caused by exposure to radiofrequency radiation emitted by smart phones. The students will be divided into three groups based on the questionnaire. Students will be asked to fill up a self – administered structured questionnaire. Swab will be obtained with swab stick method from the Buccal mucosa of students of Karpaga Vinayaga Institute of Dental Sciences. Mobile phone radiation even in permissible range if used for longer duration can cause significant cytotoxicity. The study can be concluded that there is an increased frequency of micronuclei in mobile phone users which is related to carcinogenesis.

**KEYWORDS:** Buccal Mucosa, Cytotoxicity, Electromagnetic Radiation, Micronuclei, Specific Absorption Rate, Prolonged Usage of Mobile

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### INTRODUCTION:

Cell phones have become indispensable in daily life and operate by emitting radiofrequency electromagnetic waves (RF-EMW). These devices function across different frequency bands depending on regional communication standards, and their use has expanded far beyond voice calls to include constant access to internet services, multimedia content, and social applications even among children[1]. As mobile phone usage has increased, so has prolonged exposure to RF-EMW, raising concerns about its long-term biological implications (WHO, 2006). Individuals with extended talk-time due to occupational demands or long-distance communication experience higher exposure levels[1.1]. Prior studies have shown that chronic RF-EMW exposure may induce DNA damage, promote uncontrolled cell proliferation, and reduce Protein Kinase C (PKC) activity, a mechanism potentially linked to carcinogenesis (Desai et al., 2009)[1.11]. The rate at which the human body absorbs electromagnetic radiation is quantified as the Specific Absorption Rate (SAR), expressed in watts per kilogram (W/kg). SAR is a standardized metric used to evaluate the biological impact of RF exposure[1.12].

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Regulatory bodies such as the Federal Communications Commission (FCC) have capped the permissible SAR limit of handheld devices at 1.6 W/kg to restrict potential harm (Hamada et al., 2011). Recent investigations have demonstrated measurable DNA damage in buccal mucosal cells following exposure to mobile phone radiation, suggesting a possible increased risk of cytotoxicity and malignancy in frequent users. Buccal cell analysis is widely applied in epidemiological research to study lifestyle influences, genotoxin exposure, chromosomal damage, and cell death (Thomas et al., 2009)[1.13].

During phone conversations, the handset is typically positioned close to either ear, placing the buccal mucosa in the zone of maximum RF-EMW exposure[1.14]. This anatomical proximity makes buccal epithelial cells a suitable model for assessing early cytological changes associated with mobile phone radiation. At a global level, billions of individuals are chronically exposed to high-frequency electromagnetic fields (HF-EMF), prompting concerns regarding potential associations with neoplasms such as gliomas, schwannoma, and possibly leukemia (Brabant et al., 2023)[1.15]. Supporting this, the International Agency for Research

on Cancer (IARC) has classified RF-EMF as Group 2B -“possibly carcinogenic to humans” based on epidemiological findings from the Interphone and Hardell studies (IARC, 2013). Given these concerns and the direct exposure of the buccal mucosa during phone use, the present study was undertaken to evaluate cytotoxic changes in buccal cells and correlate them with the extent of mobile phone exposure[1.16].

**MATERIALS AND METHODS**

A cross –sectional study was conducted among dental students to assess the cytological changes in buccal mucosal cells associated with varying durations of mobile phone usage. A structured, self-administered questionnaire was used to document demographic details and daily mobile usage patterns. Based on the responses, participants were stratified into three groups: students using mobile phones for 1–3 hours/day, 3–5 hours/day, and more than 5 hours/day. The study duration was three months, during which all data and sample collections were carried out.

**SAMPLE COLLECTION PROCEDURE**

Buccal mucosal samples were obtained from first-year to final-year students and interns using a sterile swab-stick technique. Each participant was instructed to rinse their mouth with sterile water before sample collection. The swab was rotated in a circular motion against the buccal mucosa to ensure adequate exfoliated cell retrieval and the collected specimen was immediately transferred into sterile containers for laboratory analysis on the same day. All samples were processed for cytological evaluation to identify micronuclei and other cellular alterations associated with mobile phone exposure.

**INCLUSION AND EXCLUSION CRITERIA**

**INCLUSION CRITERIA:** Students aged 18 years or above who provided informed consent were included in the study.

**EXCLUSION CRITERIA:** Participants below 18 years of age, those unwilling to participate, students with existing soft-tissue lesions (ulcers, lichen planus, gingivitis, aphthous ulcer) in the oral cavity and individuals undergoing long-term medication were excluded to avoid confounding factors. Ethical approval was obtained from the institutional review committee prior to the commencement of the study, and all procedures were performed in accordance with institutional research guidelines.

**LIMITATIONS:** The exact Specific Absorption Rate (SAR) and actual radiation exposure for each participant could not be measured due to variations in phone models and usage patterns. The study assumed that participants predominantly used one side of the face while talking on the phone, but this could not be objectively verified. Questionnaire-based data collection on mobile phone usage depended on participant memory, introducing recall bias.

**NOVELTY:** Previous studies on mobile phone radiation have mainly adopted a systemic approach, focusing on effects on the brain, parotid gland, and other body systems through literature reviews and theoretical analyses. These provide generalized associations but little insight into specific oral changes. In contrast, the present study focuses exclusively on the buccal mucosa—the area in closest contact with the phone during use—and evaluates it through direct clinical examination supported by questionnaire data and side-specific comparison. This localized, clinically relevant approach offers practical dental evidence and highlights an overlooked aspect of mobile phone radiation in the oral cavity.

**RESULT:**

The present study comprised 300 participants, with a mean age of 25.3 ± 4.2 years. Of the total sample, 162 participants (54%) were males and 138 participants (46%) were females. All individuals were regular mobile phone users (Table 1)

Variable	n (%)	Mean ± SD (in years)
Age (years)	300 (100%)	25.3 ± 4.2
Gender		
Male	162 (54%)	-
Female	138 (46%)	

**Table 1.** Demographic Characteristics of Study Participants (n = 300)

**MICRONUCLEI FREQUENCY ACCORDING TO GENDER:**

The mean micronucleus (MN) count among male participants was 1.34 ± 1.02, whereas female participants exhibited a mean MN count of 1.18 ± 0.96

An independent samples t-test revealed no statistically significant difference in micronucleus frequency between males and females (p = 0.142), indicating that gender did not significantly influence MN formation in buccal mucosal cells (Table 2)

Gender	N	Mean MN	Std. Deviation	p-value*
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		<b>Count</b>		
<b>Male</b>	162	<b>1.34</b>	1.02	<b>0.142</b>
<b>Female</b>	138	<b>1.18</b>	0.96	

**Table 2.** Mean Micronucleus Count by Gender (n = 300), Independent samples t-test\*P value <0.05 implies statistical significance.

Participants were categorized into short-duration mobile phone users and long-duration mobile phone users, with each group comprising 150 individuals.

1 to 3 hours users are negligible

3 to 5 hours users demonstrated a mean MN count of  $0.82 \pm 0.804$

more than 5 hours users demonstrated a substantially higher mean MN count of  $1.63 \pm 1.165$

The difference between the two groups was highly statistically significant ( $t = 6.487, df = 298, p < 0.0001$ ) (Table 3), indicating a marked increase in cytogenetic damage with prolonged mobile phone usage

Group	Mean MN Value	N	Std. Deviation	t-value	df	p-value*
<b>3 to 5 hours</b>	<b>0.82</b>	150	<b>0.804</b>	<b>6.487</b>	<b>298</b>	<b>&lt; 0.001*</b>
<b>More than 5 hours</b>	<b>1.63</b>	150	<b>1.165</b>			

**Table 3.** Mean Micronucleus Count in 3 to 5 vs. More than 5 hours Mobile Users(n = 300), Independent samples t-test.\*P value <0.05 implies statistical significance

## DISCUSSION:

The surge in mobile –phone adoption in developing nations means that the buccal mucosa situated where it receives radio-frequency radiation from phones is increasingly exposed, making it worthwhile to examine how this tissue reacts. Our research indicates that extended exposure to cell –phone emissions, especially from devices with a high specific absorption rate (SAR) and prolonged usage can lead to a modest rise in micronucleus formation[9]. We set out to assess the cytotoxic impact of phone radiation by counting micronuclei in exfoliated buccal cells; these nuclei serve as a marker of faulty cell division and chromosomal damage. Higher micronucleus counts were observed in participants who spent more time talking, suggesting a direct link between prolonged, high –SAR phone use and cytotoxic effects[10].

A written questionnaire was given to each participant to gather personal information and details about how many hours they use their phone each day. Based on the answers, the students were divided into three categories: those who use a phone 1-3 hours daily, 3-5 hours daily, and more than 5 hours daily. The study included anyone 18 years or older who signed a consent form. Excluded were anyone under 18, those who did not want to take part, students with existing oral lesions (such as ulcers, lichen planus, gingivitis, or aphthous ulcers), and anyone on long –term medication, to keep the results from being influenced by other factors.

Buccal cells were collected from first –year through final –year students and interns using a sterile swab. Participants rinsed their mouths with sterile water before the swab was rotated in a circular motion against the cheek lining to gather enough exfoliated cells, and the sample was placed in a sterile container for

same –day laboratory analysis. All specimens were examined under a microscope to look for micronuclei and other cell changes that might be linked to mobile –phone exposure.

The study included 300 people, averaging 25.3 years old ( $\pm 4.2$ ). Slightly more than half (162, 54 %) were men and 138 (46 %) were women, and everyone used a mobile phone regularly.\*Micronucleus frequency by gender\*Men had an average of  $1.34 \pm 1.02$  micronuclei per sample, while women averaged  $1.18 \pm 0.96$ . An independent –sample t –test showed no significant gender difference ( $p = 0.142$ ), meaning sex did not заметно affect micronucleus formation in the cheek cells.\*Micronucleus frequency by phone –use duration\*Participants were split evenly into 3 to 5 hours group and a more than 5 hours group, each with 150 individuals. The 3 to 5 hours group’s mean micronucleus count was  $0.82 \pm 0.80$ , whereas more than 5 hours group’s mean was  $1.63 \pm 1.17$ . This difference was highly significant ( $t = 6.487, df = 298, p < 0.0001$ ), indicating that longer daily exposure to mobile –phone radiation заметно increased cytogenetic damage.

Our findings revealed that people who talk on their phones for longer period have a markedly higher number of micronuclei than those who keep their calls brief, and the rise in micronuclei correlates with the amount of talking time. While completely abandoning mobile technology is not realistic today, a few simple precautions can lessen exposure: keep the device away from the body when you are not using it, use wired or Bluetooth headsets, switch the phone off when you do not need it, and choose a handset with a low Specific Absorption Rate (SAR). These steps can help reduce the potential harmful effects of mobile –phone radiation.

### CONCLUSION:

Within the limitations of this clinical, questionnaire-based study, a discernible association was observed between patterns of mobile phone usage and localized alterations in the buccal mucosa, particularly on the side preferentially exposed during calls. The findings suggest that chronic proximity of mobile devices to the cheek region may contribute to subtle mucosal changes that are clinically appreciable. Although a definitive cause-effect relationship cannot be established due to the cross-sectional design and absence of histopathological validation, the results highlight the buccal mucosa as a potential site of interest in the context of electromagnetic radiation exposure. This study underscores the need for further longitudinal and laboratory-based investigations to elucidate the underlying pathophysiological mechanisms and to determine the clinical significance of these observations in oral health.

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