



Research Paper

## Effect of Electromagnetic Radiation Induced DRY EYE Conditions in Human Eye

Uddeshya kumar<sup>1</sup>, Dr. Minakshi Ghosh<sup>2</sup>, Dr. K. Manoj kumar<sup>3</sup>

<sup>1</sup> Author: BOPT, Institute of Public Health and Hygiene, Mahipalpur, New Delhi (STAREXUNIVERSITY)

<sup>2</sup> Assistant professor, Department of Microbiology, Institute of Public Health and Hygiene, Mahipalpur, New Delhi

<sup>3</sup> Associate Professor, Department of Clinical Pathology, Institute of Public Health and Hygiene, Mahipalpur, New Delhi

\*Corresponding Author: (K. Manoj Kumar)

### Abstract

**Purpose-** The aim of this study is to determine the impact of dry eye induced due to electromagnetic radiation produced during use of digital screen.

**Methodology-** The project was held through camping and OPD work during the clinical posting in Haryana and New Delhi. The invitation to participate in the camping was done through social media, hoarding and pamphlet. Data collection was done in Microsoft excel sheet basis on age group. To detect dry eye in patients few test was done such as **shimmer test, TBUT test**, by slit lamp examination few things were observed which was essential to detect dry eye such as **Conjunctival Congestion, Meibomitis Dots, and Corneal shine**. After all this the statistical analysis was done.

**Result-** The EMR affected individuals were excessively used mobile phones, laptops, tablets, and PCs. According to this data, 60% of child experiences mild dry eye, 66.6% of young experiences moderate dry eye, 74 % of adult experiences serve dry eye. The test results of the present investigative study suggest that all the test results were significant at  $p < 0.05$ .

**Conclusion-** The result of the study suggests that excess use of mobile phones, tablets, laptop, and computer leads to dry eye among the patients specially having working hours more than or at least 8-10 hours.

Received 01 Aug., 2024; Revised 08 Aug., 2024; Accepted 10 Aug., 2024 © The author(s) 2024.

Published with open access at [www.questjournals.org](http://www.questjournals.org)

### I. Introduction

“Dry eye is a disorder of the tear film due to tear deficiency or excessive evaporation, which causes damage to the interpalpebral ocular surface and is associated with symptoms of ocular discomfort”, given by WHO (world health organization).

Almost all of the 50% of Red eyes and Irritable eyes are due to DRY EYE related conditions, and Tear film plays a major role in prevention of eyes from dry eye disease. The tear film is a complex mixture of substances secreted from multiple sources on the ocular surface [1, 2, 3 and 12]

- Lacrimal gland produces the watery part of the tear film called the aqueous layer which is connective layer between lipid layer and mucus layer [4, 9].
- Meibomian glands produce lipids which protect the tear film from evaporating from corneal surface
- Goblet cells of the conjunctiva are mucin producing cells which allows the wetting of the ocular surface as well as stabilizes the tear film when we blink the eye.
- Function of tear film are

1. Cleaning
2. Wetting ocular surface
3. Prevent growth of bacteria

4. Supporting the cornea (Oxygen supply) [11, 12, 13, and 14]

Effect of environment are also seen in eye in the form of Dry Eye some of the intrinsic factors are low blink rate, ageing, low androgen pool, systemic drug intake such as antihistamines, beta-blockers, and some psychotropic drugs where as some of the extrinsic factors are, low relative humidity, high wind velocity, Occupational environment [5, 6, 7, 8, and 15]. Except this dry eye also have two another type and they are

1. Aqueous-deficient
  - A. Sjogren syndrome dry eye
    - I. Primary
    - II. Secondary
  - B. Non-Sjogren dry eye
    - I. Lacrimal Deficiency
    - II. Lacrimal gland duct obstruction
    - III. Reflex block
    - IV. Systemic drugs
2. Evaporative

- A. Intrinsic
  - I. Meibomian oil deficiency
  - II. Disorder if lid aperture
  - III. Low blink rate
  - IV. Drug action accutane
- B. Extrinsic
  - I. Vitamin A deficiency
  - II. Topical drugs preservatives
  - III. Contact lens wear
  - IV. Ocular surface disease eg. Allergy [16 and 17]

The following observation led to the current study

- 1- The unexplained sadness created due to dry eye situation caused by excess use of mobile phones was shared by many of the young adult students led me to take up the study
- 2- The sudden change in the mode of study from classroom to mobile phones and computers also created dry eye in students, motivated me to take up the study.
- 3- The work in professional field suddenly switched from offline mode to online mode has created dry eye in professionals, which was a great motivation for me to take this study.

## **II. Review of Literature**

Aurora Gajta et al., 2021; studied “the effect of microwaves radiation generated by mobile phones on the tear film” in Serbia, Romania (). The purpose of the study was to investigate the effect of electromagnetic radiation (ER) emitted by the mobile phone on the tear film. For this study, they selected a total 50 subjects, young, healthy, without chronic treatment, who are not contact lens wearers and who have no history of ophthalmic surgery, schirmer I test, tear PH and tear ferning test (TFT) were performed on all subjects before (“pre”) being exposed to ER emitted by mobile phone and after (“post”) exposure for 5 minutes, the PH and TFT of the tears were performed. Following the analysis of the obtained results, were found there are significant changes in tear quality and increased tear PH, which over time can lead to tear film instability, damage to the eye surface and the appearance of dry eye.

Another study was done by Nadia I. Mohammad et al., 2015, in Egypt on the “Toxicological effects of generated radiation on the eye among computer users”. The study was done to access toxic effects of computer generated radiation on eyes among a sample of Egyptian computer users. For this research a cross-sectional study conducted on 100 volunteers from both sexes who worked daily on a computer. All participants were subjected to a half filling questionnaire including questions about personal information as well as, ocular surface disease index (OSDI). The result of the study revealed that more than three fourth (79.0%) of the studied computer workers suffered from symptoms of dry eye disease, 40.5% of them had severe dry eye affection, 26.6% had moderate and 32.9% had mild eye affection, those who have severe dry eye were using the computer for minimum 10-12 hours/day and 70.9% of them were not taking regular rest during computer work.

### III. Aim and Objective

The aim of this study is to determine the effect of electromagnetic radiation induced dry eye conditions in human eye. The main objective of the study is as follows:

- 1) To assess the mental health of the patients suffering from dry eye.
- 2) To assess the modern lifestyle affected by excess use of mobile phones and electronic devices.
- 3) To discuss the strategy for mitigation of problems related to the dry eye syndrome.

### Scope of the Study

Due to covid-19, 2020 January dry eye syndrome cases have been raised because of lockdown caused by government of India. Young adult, computer users and professionals were more affected due to excess use of mobile phones and electronic devices.

The scopes of the study are as following:

1. Assessing conjunctivitis.
2. Corneal scarring.
3. Corneal ulcer.
4. Assessment of bowman's layer of the cornea.
5. Assessment of descemet's membrane of the cornea.
6. Mitigate the problem related to dry eye syndrome.

### IV. Methodology

This investigative study '*Effect of Electromagnetic Radiation Induced DRY EYE Conditions in Human Eye*' was held through camping method and OPD work during the clinical posting. The invitation for participate in the camping was done through social media, hoarding and pamphlet, also general OPD work was held on daily basic, and camping was held in areas of Haryana and New Delhi on weekly and monthly basic according to location of camping. The study was done to draw a co-relation between excess uses of electromagnetic device [10] and its effect on human eye.

- a. **Sampling:** the process of data collection was a random process of data collection was used and total 120 patients data was collected and cluster division was done into category wise according to age.
- b. **Method:** After the screening examination of visual acuity according to chief complains, the patient was categorized for dry eye disease and further test for dryeye was done such as *shimmer test, TBUT test*, and by slit-lamp examination in severe case few things was observed which was essential to detect dry eye such as *Corneal shine, Meibomitis Dots, Conjunctival congestion* [1, 5, and 11].
- c. **Statistical analysis:** the statistical analysis was done using chi- square as statistical tool. Z- scores were calculated in case of cluster samples. The test results were validated by calculating the p- value, minimum cut off value  $p < 0.05$  was considered as a standard. The result were computed using Microsoft excel 2007.

### V. RESULTS

A demographic data was prepared according to age group considering child, young, adult, and old age category. The correlation between percentage of relative dry eye syndrome and exposure of individuals to electromagnetic radiation (EMR) is graphically represented below in figure 1 and figure 2.

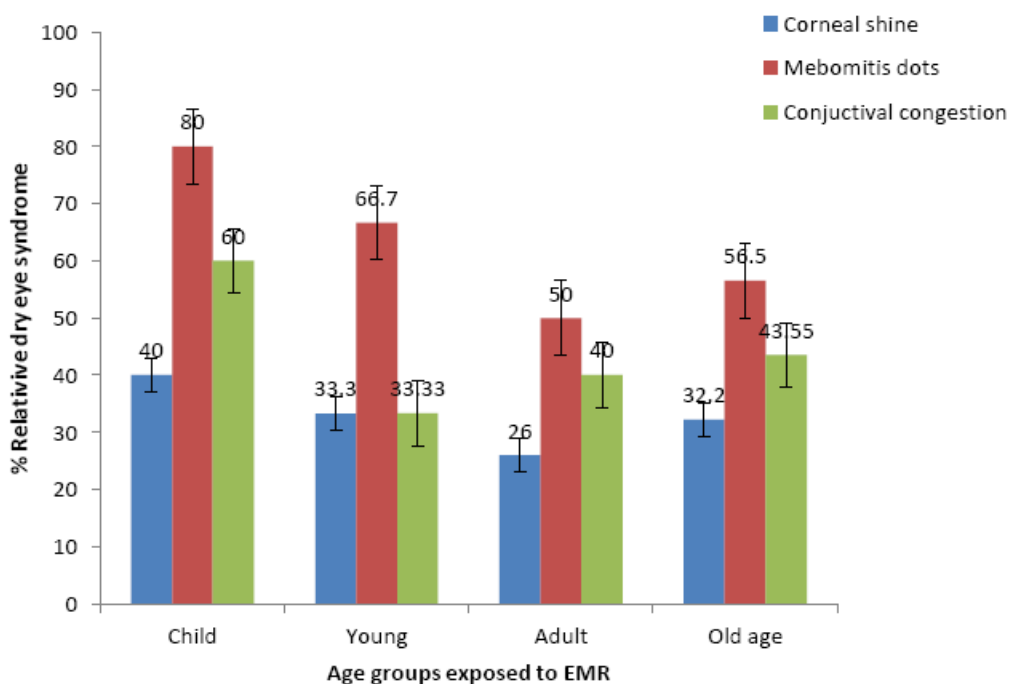


Fig. 1 Graphical representation showing percentage of unaffected age groups with no remarkable changes after exposure to EMR

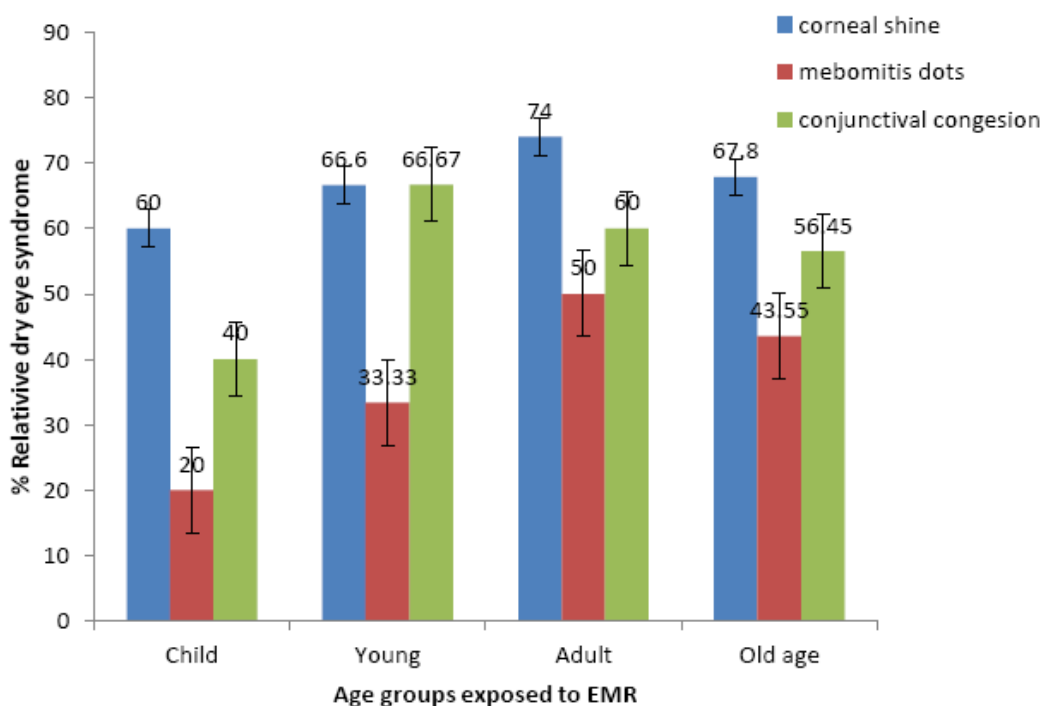


Fig. 2 Graphical representation showing percentage of affected age groups with remarkable changes after exposure to EMR.

**Table 1 Chi square value, considering degree of freedom, D.O.F = [(no. of column- no. of row) – 1], i.e; 3.**

Results						
	CHILD	YOUNG	ADULT	OLD AGE		Row Totals
DRY EYE SYNDROME	3 (3.29) [0.03]	2 (2.06) [0.00]	37 (35.82) [0.04]	42 (42.82) [0.02]		84
EMR AFFECTED	5 (4.71) [0.02]	3 (2.94) [0.00]	50 (51.18) [0.03]	62 (61.18) [0.01]		120
<i>Column Totals</i>	8	5	87	104		204 (Grand Total)

The Chi- square statistics is **0.1401**, P- value= **0.986625**

**Calculate Z from P**

This second calculator allows you to calculate the z-score for any given cumulative probability level (simply put, for any given value of *p*). Just enter your *p*- value, which must be between 0 and 1, and then hit the button below.

**Z- Score= 2.215**

P-value derived from Z- score, p- value= **0.01338**. The tests results were validated by calculating the Z- score using chi-square and statistical tool. The p value obtained was, p- value= **0.01338**. It reveals that the test results were significant at **p < 0.05**.

**VI. Discussion**

The study suggests that excess use of mobile phone; tablets, laptop, and computer have a serve effect on eye which causes dry eye in human. Patients with dry eye expressed foreign body sensation, feeling of dryness, serve redness, in few cases Meibomitis dots. Corneal shine was absent, as well as conjunctival congestion was seen in few of the patients who were suffering from dry eye. The main goal of this study was to evaluate the effect of electromagnetic radiation induced dry eye conditions in human. This research shows that people of all age groups more or less suffered from dry eye syndrome due toelectromagnetic radiation. A direct co-relation was found through the test results that imply EMR released by mobile phones, directly affects the Bowmen’s capsule and Decement membrane of cornea, in people suffering from dry eye. All the individuals affected were electronic users. The EMR affected individuals were excessively used mobile phones, laptops, tablets, and PCs. According to this data, 60% of child experiences mild dry eye, 66.6% of young experiences moderate dry eye, 74 % of adult experiences serve dry eye. The test results of the present investigative study suggest that all the test results were significant at **p < 0.05**.

The risk of dry eye was seen more in electronic users as compared to the non- users due to excess use of mobile phones, tablets, laptops, and personal computers. The adult were found to do most vulnerable as compared to the children and the other age groups. Study suggests that children, young, and aged people although less affected, has shown a remarkable change due to excess use of mobile for playing games as well as school online work (in case of children).

The youth generation is facing dry eye syndrome as this generation is more active on social media and social networking sites using either mobile phones or any other electronic devices that generates potential electromagnetic radiation, causing dry eye in the youth generation.

**VII. Conclusion**

The result of the study suggests that excess use of mobile phones, tablets, laptop, and computer leads to dry eye among the patients specially having working hours more than or at least 8-10 hours. The result from the study is only an indication about devastation of the most important wealth (i.e the children and youth of our country). Study suggests, despite of the ways of survival in term of online education, online recreation and telemedicine. The entire populations’ especially electronic users’ needs to dig deep and find alternate ways of building a proper Eye health rather than web network which has been created now days to fulfill all physical needs or some day it may become futile in our near future.

It is suggested that regular eye checkup should be conducted through offline mode by visiting a near clinic along with this regular screening program must be conducted in schoolsto check the eye health of kids. A

screening program must be conducted by corporate company to check the eye conditions of their staffs working on the screen. A continuous motivational and inspirational series of program to be run by universities and companies for better eye health and protect eye form dry eye disease caused due to excess use of mobile phones.

### Reference

- [1]. Gajta A et al. The effect of Microwave Radiation Generated by Mobile Phones on the Tear Film. *Revista Romana Medicina de Laborator*, Vol 29(3), 2021, DOI: 10.2478/rmlm-2021-0019.s
- [2]. Am M, Ra F, El-Naggar AH, Tm A; Akhtar S. Structure and microanalysis of tear film ferning of camel tears, human tears, and Refresh Plus. *Mol Vis*. 2018 Apr 16; 24:305-14.
- [3]. Barjovanu F, Mocanu C, Mercuț G. Testul de cris-Nr. 3, Iulie, 2021286talizare a lacrimilor in sindromul sicca [The tear crystallization test in sicca syndrome]. *Oftalmologia*. 2006;50(4):54-9.
- [4]. Choi JH, Li Y, Kim SH, Jin R, Kim YH, Choi W, You IC, Yoon KC. The influences of smartphone use on the status of the tear film and ocular surface. *PLoS One*. 2018 Oct 31;13(10):e0206541. DOI: 10.1371/journal.pone.0206541
- [5]. Elder JA. Ocular effects of radiofrequency energy. *Bioelectromagnetics*. 2003;Suppl 6:S148-61. DOI: 10.1002/bem.10117
- [6]. George DF, Bilek MM, McKenzie DR. Non-thermal effects in the microwave induced unfolding of proteins observed by chaperone binding. *Bioelectromagnetics*. 2008 May;29(4):324-30. DOI: 10.1002/bem.20382
- [7]. Kıvrak EG, Yurt KK, Kaplan AA, Alkan I, Altun G. Effects of electromagnetic fields exposure on the antioxidant defense system. *J Microsc Ultrastruct*. 2017;5(4):167-6. DOI: 10.1016/j.jmau.2017.07.003
- [8]. Lixia S, Yao K, Kaijun W, Deqiang L, Huajun H, Xian-gwei G, Baohong W, Wei Z, Jianling L, Wei W. Effects of 1.8 GHz radiofrequency field on DNA damage and expression of heat shock protein 70 in human lens epithelial cells. *Mutat Res*. 2006 Dec 1;602(1-2):135-42. DOI: 10.1016/j.mrfmmm.2006.08.010
- [9]. Masmali AM, Purslow C, Murphy PJ. The tear ferning test: a simple clinical technique to evaluate the ocular tear film. *Clin Exp Optom*. 2014 Sep; 97(5):399-406. DOI: 10.1111/cxo.12160
- [10]. Munshi S, Varghese A, Dhar-Munshi S. Computer vision syndrome-A common cause of unexplained visual symptoms in the modern era. *Int J Clin Pract*. 2017;71. DOI: 10.1111/ijcp.12962
- [11]. Norn M. Quantitative tear ferning. *Clinical investigations. Acta Ophthalmol (Copenh)*. 1994 Jun;72(3):369-72. DOI: 10.1111/j.1755-3768.1994.tb02775.
- [12]. Sharanjeet-Kaur, Ho CY, Mutalib HA, Ghazali AR. The Relationship Between Tear Ferning Patterns and Non-invasive Tear Break-up Time in Normal Asian Population. *J Optom*. 2016;9(3):175-81. DOI: 10.1016/j.optom.2015.10.004
- [13]. Tavares Fde P, Fernandes RS, Bernardes TF, Bonfioli AA, Soares EJ. Dry eye disease. *Se-min Ophthalmol*. 2010 May;25(3):84-93. DOI: 10.3109/08820538.2010.488568
- [14]. Vignal R, Crouzier D, Dabouis V, Debouzy JC. Effets des ondes hyperfréquences des téléphones mobiles et des radars sur l'oeil [Effects of mobile phones and radar radiofrequencies on the eye]. *Pathol Biol (Paris)*. 2009 Sep;57(6):503-8. DOI: 10.1016/j.patbio.2008.09.003
- [15]. Wang J, Koyama S, Komatsubara Y, Suzuki Y, Taki M, Miyakoshi J. Effects of a 2450 MHz high-frequency electromagnetic field with a wide range of SARs on the induction of heat-shock proteins in A172 cells. *Bioelectromagnetics*. 2006; 27:479-86. DOI: 10.1002/bem.20226
- [16]. Wang KJ, Yao K, Lu DQ, Jiang H, Tan J, Xu W. [Effect of low-intensity microwave radiation on proliferation of cultured epithelial cells of rabbit lens]. *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi*. 2003 Oct;21(5):346-9.
- [17]. Yu Y, Yao K. Non-thermal cellular effects of low power microwave radiation on the lens and lens epithelial cells. *J Int. Med. Res*. 2010;38(3):729-36. DOI: 10.1177/147323001003800301