Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/14343
DOI URL: http://dx.doi.org/10.21474/IJAR01/14343

RESEARCH ARTICLE

EFFECT OF SCREEN TIME ON ORAL HEALTH STATUS IN CHILDREN-AN EXPERIMENTAL STUDY WITH SALIVARY ANALYSIS

Voleti Sri Srujana Aravinda[1], Chaitanya Ram Kandregula[2], P. Shreya[3], Madhavi Krishna M.[2], B.S. Nikitha[4] and Malathi Yenni[4]

1. Postgraduate Anil Neerukonda Institute of Dental Sciences Visakhapatnam Andhra Pradesh, India.
2. Associate Professor Anil Neerukonda Institute of Dental Sciences Visakhapatnam Andhra Pradesh, India.
3. Undergraduate Anil Neerukonda Institute of Dental Sciences Visakhapatnam Andhra Pradesh, India.
4. Assistant Professor Anil Neerukonda institute of Dental Sciences Visakhapatnam Andhra Pradesh, India.

Manuscript Info

Manuscript History
Received: 25 December 2021
Final Accepted: 30 January 2022
Published: February 2022

Key words:-
Electromagnetic Radiation, Saliva, Salivary Amylase, Cell Phone, Children

Abstract

Background: The prospect of side effects associated with the electromagnetic waves emitted by the mobile phones is a questioned issue. The current study was designed to assess the impact of mobile phone use on salivary concentrations of amylase in children.

Methods: The children were divided into dominant and non-dominant groups based on the questionnaire. For each subject, saliva samples from the dominant and non-dominant mobile phone users were collected. Salivary flow rate and salivary concentrations of proteinamylase were measured. Data were analysed using one-way analyses of variance and t-tests conducted with the statistical software version 18 (SPSS; Chicago, Illinois, USA).

Results: Salivary flow rate and salivary concentrations of protein amylase were significantly higher in the non- dominant group than the dominant group.

Conclusion: The dominant mobile phone use was associated with differences in salivary flow rate and salivary concentrations of amylase. Significant changes in salivary amylase and salivary flow rate suggest the adverse effects of the high use of cell phones on cell health in children.

Introduction:-

In today's modern media-driven world, many parents use screens to keep young children entertained or distracted while attending to other needs. Screens captivate children's attention in a way almost nothing else does. Over the past decade, the use of cell phones has increased significantly. The extensive usage aggravates the health concerns about viable risks associated with exposure to electromagnetic fields produced by this technology.[1]

Recently, with the advent of cell phones, research showed that there is consequential effect on the oral cavity which elicits concern.

Salivary fluid is an exocrine secretion [2,3] consisting of approximately 99% water, containing a variety of electrolytes and proteins, represented by enzymes, immunoglobulins, and other anti-microbial factors, mucosal glycoproteins,

Corresponding Author:- Voleti Sri Srujana Aravinda
Address:- Postgraduate Anil Neerukonda Institute of Dental Sciences Visakhapatnam Andhra Pradesh, India.

traces of albumin, some polypeptides and oligopeptides of importance to oral health.[4,5] A healthy person's mean daily saliva production ranges from 1 to 1.5L. The functions of saliva are lubrication, buffering action, cleansing, mucosal integrity and many more.[6]

Amylase, one among the constituents of saliva, plays a vital role as it begins the chemical digestion process. The enzyme breakdowns the food so that it can easily be digested and releases all the nutrients from the food, which are absorbed into the body. [7]

In the past, extensive studies have been done on the effect of mobile phone usage in direct proportionality to the time of its usage. Clinical symptoms such as burning sensation, tingling of the skin on the head and extremities, fatigue, sleeping disorders, vertigo, mental distraction, increased reaction time, diminished memory, headaches, weakness, palpations, and digestive system dsturbances were reported[8.]Although a cause-effect relationship has not been established conclusively; there is a possibility that carcinoma incidence and other genetic conditions may be associated with such exposure.[9]

Due to this pandemic, the usage of virtual reality has increased drastically, increasing screen time, especially in children in the form of classes held in a web-supported format. When relating these two, the global trend and oral cavity, there has beena tremendous increase in the usage of mobile phones over the last two decades.

The present study evaluates the quantity of unstimulated saliva produced depending on the amount of time spent on the mobile. In addition, to assessthe salivary concentration of amylase and compare the concentrations between dominant and non-dominant mobile phone users.

Materials and Methods:-

This study was carried out in the outpatient Department of Paediatric and Preventive Dentistry, Anil Neerukonda Institute of Dental Sciences, Visakhapatnam. Inclusion criteria 1) Children aged between 4-14 years are included. 2) Children with no systemic disorders. 3) Children not under any medication.Exclusion criteria 1) Children with systemic diseases. 2) Children who are on long-term medication. Implication:

To evaluate the effect of screen time on oral health and what necessary precautions can be taken to decrease the impact on the oral health status.

Methodology:-

Through random sampling, 60 children were chosen and allocated into dominantand non-dominant group based on the questionnaire [Fig I].

Equitable gender distribution was ensured. After explaining the study's aim and completing the demographic data sheet, informed consent was taken from each participant. All subjects were assured that the data they provided would be confidential and would only be used for statistical analysis. For each subject, saliva samples from the dominant and non-dominant mobile phone users were collected and compared.

Study questionnaire – Effect of Screen time on Oral Health status in children – An Experimental Study with Salivary Analysis

Mother/Father's name

Name of your child

Age of your child

Class of your child

Sex

1) Does the child eat on his/her own?
   a) Yes b) no
2) Does he/ she watch Mobile phone while eating?
   a) Yes b) no
3) What amount of time he/ she has taken to eat per meal?
   a) 15 min b) 15-30 min c) 30-45min d) 45-60min
4) What is the amount of time that child spends watching the Mobile phone in a day?
   a) < 60 min or less than 60 min
   b) > 60 min or greater than 60 min
5) What is the amount of food consumption while watching the Mobile phone?
   a) Less than 2 katori of rice
   b) More than 2 katori of rice
6) Does the child maintain a distance of 30cm/1 feet while watching the Mobile phone?
   a) Yes b) no
7) Is the child relishing the food while watching the Mobile phone?
   a) Yes b) no
8) Do you know that radiation from prolonged Mobile phone viewing affects the oral cavity secretion?
   a) Yes b) no
9) What according to you is the alternative tool to replace the Mobile phone while eating?
   a) Toys b) electronic devices
10) Is the child ready to quit the habit of Mobile phone viewing while eating?
   a) Yes b) no
11) Do you feel that a child's mental health would be stable due to prolonged mobile phone viewing?
   a) Yes b) no

Fig 1:- Questionnaireused to categorize children into dominant and non -dominant groups.

Measurements:-

After completing the questionnaire on mobile phone usage, Unstimulated salivary samples were collected from children in the dental chair in a relaxed atmosphere under proper lighting conditions. (FigII)
Unstimulated salivary sample collections were done in a measured beaker for 2 minutes and kept on ice during and after sample collection. The samples were then transferred to the pathobiology laboratory and kept in a frozen state at -18C until all subjects were collected. To determine the activity of salivary amylase, the frozen samples were placed at an ambient temperature for 30 minutes before being centrifuged at 3500 revolutions per minute for 20 minutes.

FigII:- a collection of salivary samples from children in a measured test tube.

Using appropriate samplers, the supernatant clear fluid was then transferred into an Eppendorf microtube Sigma-Aldrich, St. Louis, Missouri, USA) using suitable samplers. The particulars of each sample were inscribed on each microtube.[10]

Procedure:-

Principles of the Procedure: The Slide is a multi-layered, analytical element coated polyester support. A drop of the patient's saliva sample is deposited on the vitros amyl slide and is distributed evenly by the spreading layer to the underlying layers. The spreading layer comprises the dyed starch substrate (dye covalently linked to amylopectin) for the reaction. The amylase in the sample catalyses the hydrolysis of this dyed starch into smaller dyed saccharides. The dyed saccharides formed diffuse into the underlying reagent layer. Then the reflection density of these dyed saccharides in the reagent layer is measured by reflectance spectrophotometry at 2.3 for 5 minutes (fig III). The difference in the slide's reflection density between the two readings is proportional to sample amylase activity.[11] The handling of the reagent is given in fig IV.

Table I:- Showing the reaction of the salivary amylase sample.

Test type	VITROS system	Approximate incubation time	Temperature	wavelength	Reaction sample volume
Two-point rate	5600, 4600, 5,1 FS, 250/350, XT 7600, XT 3400	5minutes	37C(98.6F)	540nm	10 µL

Table II:- Reaction scheme.

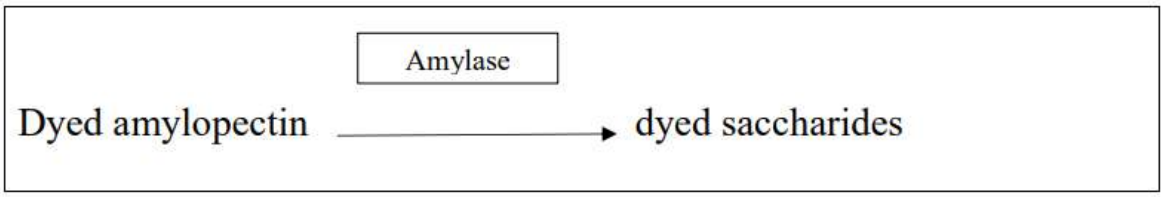

Figure III:- Slide preparation for the salivary amylase extraction from the saliva sample.

Reagents

Slide Ingredients

Reactive Ingredients per cm²
Dyed amylopectin 291µg.

Other Ingredients
Pigment, binders, buffers, mordant, surfactants and stabilizer.

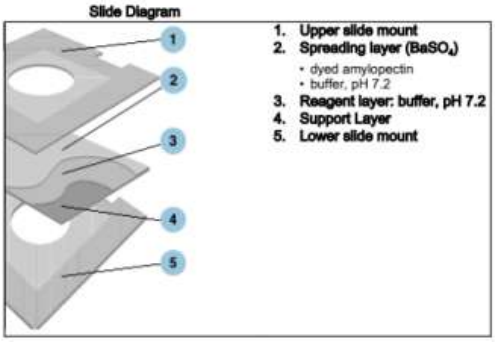

Figure IV:- Handling properties for the reagent.

Reagent Handling

Caution: Do not use slide cartridges with damaged or incompletely sealed packaging.

- Inspect the packaging for signs of damage.
- Be careful when opening the outer packaging with a sharp instrument so as to avoid damage to the individual product packaging.

Reagent Preparation

IMPORTANT: The slide cartridge must reach room temperature, 18–28 °C (64–82 °F), before it is unwrapped and loaded into the slide supply.

1. Remove the slide cartridges from storage.
2. Warm the wrapped cartridge at room temperature for 30 minutes when taken from the refrigerator or 60 minutes from the freezer.
3. Unwrap and load the cartridge into the slide supply.

Note: Load the cartridges within 24 hours after they reach room temperature, 18–28 °C (64–82 °F).

Reagent Storage and Stability

VITROS AMYL Slides are stable until the expiration date on the carton when they are stored and handled as specified. Do not use beyond the expiration date.

Reagent	Storage Condition		Stability
Unopened	Refrigerated	2–8 °C (36–46 °F)	≤ 4 weeks
	Frozen	≤-18 °C (≤0 °F)	Until expiration date
Opened	On-analyzer	System turned on	≤ 2 weeks
	On-analyzer	System turned off	≤ 2 hours

Analysis:
Data was analysed using one-way analyses of variance and t-tests conducted with the statistical software version 18 (SPSS;Chicago,Illinois,USA). Statistical significance was well-defined as $p < 0.05$.

Results:-

Table III:- Salivary Amylase concentration

Group	N	Mean	Std. Deviation	p-value
Dominant	31	9.1935	3.36075	0.000
Non-dominant	28	4.3214	1.98240	

Graph I. Bar representation of Amylase concentration in Dominant and Non-Dominant groups

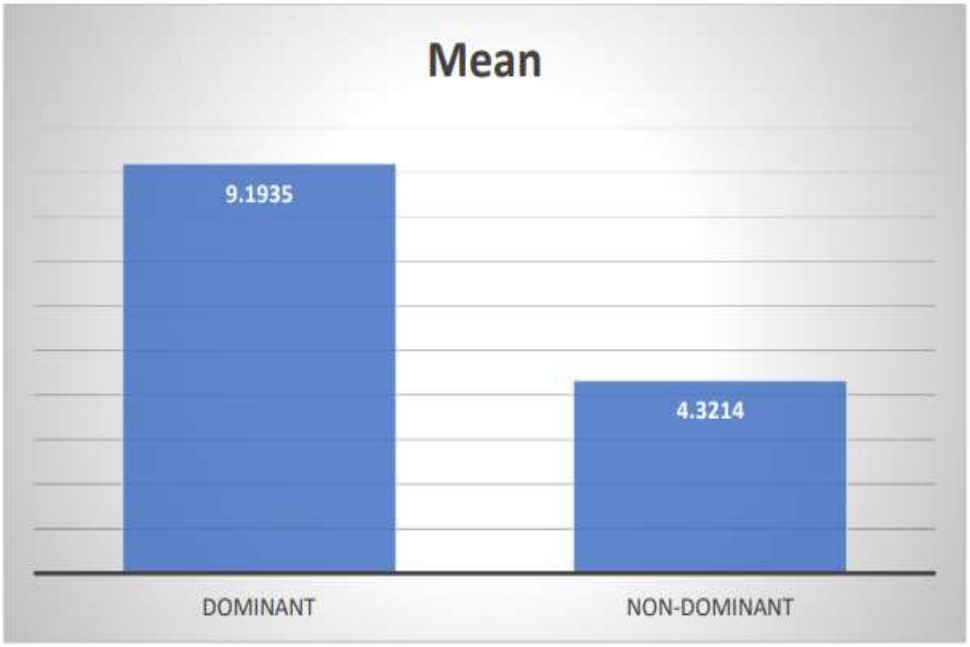

Table IV Salivary flow rate in dominant and non-dominant groups

GROUP	N	Mean	Std. Deviation	p-value
Dominant	31	.852	.4567	0.000
Non-dominant	28	2.675	.5667	

Graph II:- Bar representation of salivary flow rate of Dominant and Non-Dominant groups.

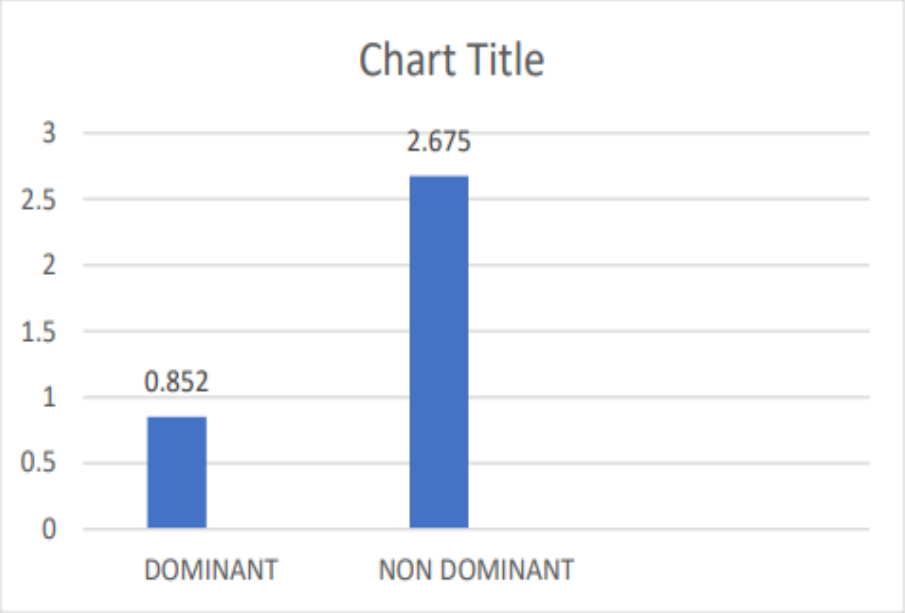

Table III shows a rise in amylase concentration in the dominant category compared to the non-dominant with a mean value of 9.1935 for dominant and 4.3214 for non-dominant, showing a higher range of amylase production with increased duration of mobile phone usage with P-value <0.000 showing highly significant.

Graph I showing the graphical representation of amylase concentration in dominant and non-dominant groups.

Table IV depicts the comparison of the salivary flow rate of the two groups, dominant and non-dominant group; the non-dominant group showed a high salivary flow rate with a mean value of 2.675, wherein the dominant group showed 0.852 with P<0.000 showing high significance, it also implies that duration of the mobile phone is inversely proportional to the salivary flow, i.e., increased duration of mobile phones decreased salivary flow rate.

Graph II shows the graphical representation of the comparison of salivary flow between dominant and non-dominant groups.

The results in both tables III and IV depictedan increase in salivary amylase concentration in the dominant group and decreased salivary flow rate in the dominant group with increased time duration of mobile phone usage, which is vice-versa for the non-dominant group, i.e., decreased salivary amylase concentration and increased salivary flow with decreased time duration of mobile phone usage.

Discussion:-

The use of digital technology has raised rapidly during the last two decades. Mobile phones emit radiofrequency (RF) radiation during use. the scientific evidence on theevaluation of brain tumor risk was made by the International Agency for Research on Cancer in May 2011 concluded that radiofrequency radiation emitted from devices in the frequency range 30 kHz–300 GHz is a Group 2B, a "possible" human carcinogen. [12]Potential health effects of cell phone use have not been adequately examined in children. As children are using cell phones at earlier ages, research among this group has been identified as the highest priority by both national and international organizations. Exposure to cell phone prenatally and a lesser degree postnatally was associated with more behavioral difficulties.[13]

Early disease detection is vital to reduce disease severity and prevent complications and critical to increase the success rate of any therapy. Saliva has been studied widely as a potential diagnostic tool due to its ease and non-invasive accessibility, along with its abundance of biomarkers, and proteins[14]. The use of saliva to identify individuals with the disease and to follow the affected individual's progress has attracted the attention of numerous investigators. Its non-invasive method of collection, simplicity, and cost-effectiveness make it a valuable tool to the

general practitioner and the paediatric dentist1[3] saliva as a diagnostic fluid offers distinctive advantages over serum because it can be collected non-invasively by individuals with modest training. Furthermore, saliva may provide a cost-effective approach for screening large populations. The whole saliva may be used to diagnose systemic diseases because it contains serum constituents1[4]. The concentration of saliva's substances varies according to the responses to physiological processes in the human body. Genetic constituents such as DNA and RNA also highlight saliva as a potential diagnostic tool[17]. A saliva is a vital tool containing biomarkers used in the diagnosis and treatment of many oral and systemic diseases. [18] Saliva analysis has advantages such as being non-invasive, cheaper than blood tests, good patient cooperation, and low technical sensitivity. It is also promising for its ease of collecting and storing samples[17]. Alpha-amylase is the primary form of amylase found in humans, most prominently in pancreatic juice and saliva. The salivary amylase is an amylolytic enzyme that acts on cooked or boiled starch and converts it into maltose. It has become interesting to study the behavior of salivary amylase when it is secreted as a result of different stimuli. [18] Salivary amylase is a glucose-polymer cleavage enzyme synthesized by the salivary glands. It contains a small portion of the total amylase excreted, made mainly by the pancreas. Amylases digest starch into smaller molecules, ultimately yielding maltose, which in turn is cleaved into two glucose molecules by maltase.[19]

Internationally, there has been aincrease in the number of people using hand-held mobile phones over the past two decades[20,21]. Human beings are exposed to radiofrequency radiation emitted by the mobile phone device (which operates as a receiver and a transmitter),which has created a need to investigate possible ill effects of mobile phone use on individuals'health of individuals [22,23]. Cell phones have been considered modern man's nemesis. Reports indicate a wide range of adverse effects of long-term usage of cell phones on the reproductive system, nervous system, cornea, gastrointestinal system, and kidneys [24,25,26]. The negative effects of electromagnetic radiations have been proposed to be mediated by various mechanisms like increasing the generation of free radicals [27], alterations in gene expression [28], damage to DNA, loss of DNA integrity[29], and chromosomal instability[30]. Studies have reported increased lipid peroxidation and decreased levels of antioxidants in the blood of regular cell phone users [31,32], and in the blood and tissues of experimental animals exposed to electromagnetic radiations for prolonged periods [33,34]. Due to the present pandemic situation, as usage of mobile phones isin high demand, the current study was commenced to evaluate the effect of screen time on children's oral health. Saliva is an underused diagnostic tool, gaining a lot of attention in the last three decades due to the non-invasiveness of its collection, non-necessity of skilled persons, and special equipment for its collection[35]. Researchers worldwide have attempted to evaluate the practicality of salivary constituents as biomarkers of systemic diseases, malignancy, infectious diseases, drug toxicity, and hormonal imbalances[35]. Due to its non-invasiveness, saliva was selected for the present study for evaluation. Salivary amylase activity was significantly higher in high mobile users, indicating the adverse effect of mobile phone use on cell health. Previous studies have reported increased salivary amylase in oral cancer [36.] Thus, the evaluation of the amylase was taken into consideration.

A previous study has reported increased salivary cortisol and amylase levels on exposure to electromagnetic radiations from the Global System for Mobile Communication (GSM) mobile base station[37]. Recently, a study has observed decreased salivary flow, total protein, albumin, and amylase activity in mobile phone users [38]. This supports the present study where there is a rise in the salivary amylase concentration and decreased salivary flow rate in the dominant group. Comparing the salivary flow rate in children of the dominant group is less than the non-dominant group, which is contradicting to the various studies [39,40,41]

Limitations:
However, this was a preliminary project and had the limits of a small sample size and only assessing saliva. We also could not ascertain the wave strength of the mobiles used, different companies of smartphones used, and the effect of only hand-held mobile phone use was considered.

Conclusion:-
The findings of this study suggest an adverse effect of mobile phone usage on oral health as indicated by increased salivary amylase and decreased salivary flow rate in children, wherein salivary biochemical parameters have served as sensitive indicators of oral health in mobile users. The age group of the children might be the reason for the decrease in salivary flow rate in the dominant group, which was vice-versa for the adult group.

Extension of the study:
As an extension of the present research on the same children, a comparison of the effect of the screen time on the oral health status of the children between dominant and non-dominant categories at the cellular level, the buccal

swab was collected and sent for buccal mucosa sampling,and cytological evaluation was carried out showing the presence of abnormal cells.

References:-

1. International telecommunication union. Statistics of mobile cellular. Switzerland: ICT Data and statistics.
2. Berkovitz BKB, Holland GR, Moxham BJ. Oral anatomy, histology, and embryology. 3rd ed. New York: Mosby; 2002.
3. Ferraris MEG, Munõz AC. Histologia e embriologiabucodental. ed. Rio de Janeiro: Guanabara Koogan; 2006.
4. Humphrey SP, Williamson RT. A review of saliva: Normal composition, flow, and function. J Prosthet Dent. 2001; 85:162-169.
5. Dawes C, Pedersen AML, Villa A, Ekström J, Proctor GB, Vissink A, et al. The functions of human saliva: A review sponsored by the World Workshop on Oral Medicine VI. Arch Oral Biol. 2015; 60:863–74.
6. Schiiz J, Bohler E, Berg G, Schlehofer B, Hettinger I, Schlaefer K et al. Cellular phones, cordless phones, and the risks of glioma and meningioma. Am J Epidemiol 2006; 163: 512 – 20.
7. Ramasubbu N, Paloth V, Luo Y, Brayer GD, Levine MJ. Structure of human salivary alpha-amylase at 1.6 A resolution: implications for its role in the oral cavity. Acta Crystallogr D BiolCrystallogr 1996; 52: 435- 46
8. World Health Organization. WHO research agenda for radiofrequency fields. World Health Organization: Geneva, 2006.
9. Swerdlow AJ, Feychting M, Green AC, LeekaKheifets LK, Savitz DA. Mobile phones, brain tumors, and the interphone study: where are we now?EnvironHealthPerspect.2011;119(11):1534-8.
10. MS Hashemipor,MYarbhakt,AGholamhosseinian,HFamori.Effect Of Mibile Phone Use On Salivary Concentrations Of Protein, Amylase, Lipase, Immunoglobulin A, Lysozyme, Lactoferrin, Peroxidase And C-Reactive Protein of The Parotid Gland.JLO(2014),128,454-462.
11. Vitros chemistry, Instructions for use, Vitros chemistry products AMYL slides, methodology.
12. Lennart Hardell Effects of Mobile Phones on Children's and Adolescents' Health: A CommentaryChild Development, 2017, Volume 00, Number 0, Pages 1–4
13. Hozefa A Divan,1 Leeka Kheifets,2 Carsten Obel,3 Jørn Olsen2,3Cell phone use and behavioral problems in young children. J Epidemiol Community Health (2010): 62–64.
14. Mohammad A. Javaid,Ahad S. Ahmed, Robert Durand, Simon D. Trend, Saliva as a diagnostic tool for oral and systemic diseases J Oral BiolCraniofac Res. 2016 Jan-Apr; 6(1): 66–75
15. Prabhakar AR, Akanksha Gulati, Deepak Mehta, SugandhanSDiagnostic Applications of Saliva in Dentistry.International Journal of Clinical Pediatric Dentistry, September-December 2009;2(3):7-13
16. Vijaya Lakshmi Madalli. Saliva-A Diagnostic Tool. January 2013 Journal Of Dental And Medical Sciences 11(6):96-99
17. Ozlem Kart,AysenYarat.SalivaAs A Diagnostic Tool in Oral Diseases.Experiment 2020;10(3):135-9
18. Prem Jose Vazhacharickal, Sajeshkumar N.K, Jiby John Mathew and Twinkle Jose Behaviour of salivary amylase in various reaction environments with reference to Km and Vmax: an overview. May 2017.Publisher: Grin Publishers, Germany.
19. Catherine Peyrot des Gachons, Paul Breslin.Salivary Amylase: Digestion and Metabolic Syndrome. Curr Diab Rep (2016) 16:102.
20. World Health Organization. WHO research agenda for radiofrequency fields. World Health Organization: Geneva, 2006.
21. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. Cell phones: modern man's nemesis? Reprod Biomed. 2009;18:148-57
22. Hyland GJ. Physics and biology of mobile telephony. Lancet. 2000;356:1833– 36.
23. Khurana VG, Teo C, Bittar RG. Health risks of cell phone technology. Surg Neurol. 2009 72(4):436-37
24. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. Cell phones: modern man's nemesis? Reprod Biomed. 2009;18:148-57
25. Goodman R, Blank M. Insights into electromagnetic interaction mechanisms. J Cell Physiol. 2002;192:6-22.
26. Hardell L, Carlberg M, Hansson Mild K.. Epidemiological evidence for an association between the use of wireless phones and tumor diseases. Pathophysiol. 2009;16(2-3):113-22.
27. Kovacic P, Somanathan R. Electromagnetic fields: mechanism, cell signaling, other bioprocesses, toxicity, radicals, antioxidants, and beneficial effects. J Recept Signal Transduct Res. 2010;30:214-26.
28. Pacini S, Ruggiero M, Sardi I, Aterini S, Gulisano F, Gulisano M. Exposure to global system for mobile communication (GSM) cellular phone radiofrequency alters gene expression, proliferation, and morphology of human skin fibroblasts. Oncol Res. 2002;13:19–24.

29. Aitken R, Bennetts L, Sawyer D, Wiklendt A, King B. Impact of radiofrequency electromagnetic radiation on DNA integrity in the male germline. Int J Androl. 2005;28:171–79.
30. Mashevich M, Folkman D, Kesar A, Barbul A, Korenstein R, Jerby E, et al. Exposure of human peripheral blood lymphocytes to electromagnetic fields associated with cellular phones leads to chromosomal instability. Bioelectromagnetics. 2003;24:82–90
31. Kovacic P, Somanathan R. Electromagnetic fields: mechanism, cell signaling, other bioprocesses, toxicity, radicals, antioxidants, and beneficial effects. J Recept Signal Transduct Res. 2010;30:214-26.
32. Moustafa YM, Moustafa RM, Belay A, Abou-El-Ela SH, Ali FM. Effects of acute exposure to the radiofrequency fields of cellular phones on plasma lipid peroxide and antioxidase activities in human erythrocytes. J Pharm Biomed Anal. 2001;26:605-08.
33. Desai NR, Kesari KK, Agarwal A. Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on the male reproductive system. ReprodBiol Endocrinol. 2009;7:114- 19.
34. Achudume AC, Onibere B, Aina F. Bioeffects of the electromagnetic base station on glutathione reductase, lipid peroxidation and total cholesterol in different tissues of Wistar rats. Biol Med. 2009;1:33-38
35. Kaufmann E. Lamster IB. The diagnostic applications of saliva, a review. Crit Rev Oral Biol Med. 2002;13:197-212.
36. Shivashankara AR, Martyr SS, Thomas T, Lobo ADA, Baliga MS. A Comparative and Correlative Study of Amylase, Lactate Dehydrogenase, Glutathione S-Transferase, and Total Antioxidant Capacity in Blood and Saliva in Oral cancer. Int J Biochem-Photon. 2013;108:238-43.
37. Augner C, Hacker GW, Oberfeld G, Florian M, Hitzl W, Hutter J, et al. Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A. Biomed Environ Sci. 2010;23: 199- 207
38. Hamzany Y, Feinmesser R, Spitzer T, Mizrachi A, Hilly O, Hod R, et al. Is human saliva an indicator of the adverse health effects of using mobile phones? Antioxid Redox Signal. 2013;18: 622-27.
39. Goldwein O, AframianDj (2010). The influence of hand-held mobile phones on human parotid gland secretion. Oral Dis, 2010, 16(2):146-150.
40. Bhargava S, Motwani MB, Patni VM (2012). Effect of hand-held mobile phone use on parotid gland salivary flow rate and volume. Oral Surg Oral Med Oral Pathol Oral Radiol, 114(2):200-6.
41. Duan Y, Zhang HZ, Bu RF (2011). Correlation between cellular phone use and epithelial parotid gland malignancies. Int J Oral MaxillofacSurg, 40(9):966-72.