



Chance to Avoid New Caries and Circumstances in Elderly Patients - A Retrospective Study

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ABSTRACT

The prevalence of coronal and root surface caries are found to be high among the elderly populations globally causing tooth loss. This tooth loss affects their quality of life by compromising the chewing ability. Thus there is a need to identify the factors which increase the risk for dental caries among them. Cariogram is a software developed to assess the caries risk. The aim of this study was to evaluate the chance to avoid new caries and circumstances in elderly patients. A retrospective study was conducted using the patient records of University hospital from June 2019 - April 2020. Consecutive case records of patients aged above 60 years with data on caries risk assessment by Cariogram, irrespective of gender was retrieved and statistically analysed. Frequency distribution, independent t test were employed with a level of significance set at $p < 0.05$. The mean age among the elderly patients was 65.8 ± 5.1 years with 62.19% males and 37.81% females. The mean circumstances among males was 7.79 and females was 8.34. The mean estimated chance to avoid new caries among males was 47.79 and females was 46.06. There was a statistically significant association between the chance to avoid new caries and circumstances in patients above 60 years of age ($p = 0.025$). The chance of avoiding new caries was higher in patients with low previous caries experience and no systemic diseases. Females have more caries risk than males among the elderly population

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INTRODUCTION

Oral health remains an indicator for "active ageing." Routine assessment of oral health among the aged population is included in the WHO policy proposals [1], [2]. Increased prevalence of coronal, root surface caries and periodontal disease, increases the prevalence of tooth loss among the elderly. [3],[4]. The increase in prevalence of oral diseases among elderly can be attributed to their deteriorating manual dexterity which makes it

difficult for them to maintain proper oral hygiene [5]. Dental caries, a multifactorial disease, is a major public health problem among all age groups globally [6], [7]. The risk factors for dental caries among elderly includes systemic diseases, diet pattern, diet frequency, amount of plaque, decreased salivary secretion, pH, fluoride programs, amount and type of microorganisms, host susceptibility, social and behavioral factors [8],[9], [10].

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Evidence has shown that diet plays a major role in causing dental caries, also dental caries can be prevented [11]. Assessment of diet content and frequency among elderly becomes the utmost importance in caries risk assessment. The caries risk assessment helps in making decisions to prevent and treat dental caries [12], [13]. Furthermore, there is an increased risk of caries and periodontitis among the aging population due to general chronic diseases such as Dementia and Alzheimers where manual dexterity and smoking habit plays a vital role [14]. [15].

Literatures have reported a significant correlation between the various components of Cariogram like diet, microbiological factors, saliva secretion, fluoride, previous caries experience with estimated chance to avoid new caries among adults and adolescents [16],[17],[18], [19]. However there is a lacunae in research in assessing the caries risk among elderly population using Cariogram software. Caries risk assessment will help in educating the elderly people and their caregivers on preventive measures of dental caries [20]. Customized preventive programs targeting the relevant risk factors should be directed since there is much variation in the impact of risk factors among elderly [21],[22]. Therefore, there is a high time needed for early identification and curbing of relevant risk factors for dental caries among older people. Previously we have focused our research on various invitro and invivo studies. [23–42] We have currently shifted our focus to this retrospective analysis. This study thus aimed to assess the chance to avoid new caries and circumstances in elderly population using Cariogram.

MATERIALS AND METHODS

Study setting and design

A retrospective study was designed and conducted by reviewing 86,000 case records of patients from the author’s University hospital for a period of ten months (June 2019 - April 2020).

Ethical approval

Prior approval to carry out the study was obtained from the Institutional Research Committee of the authors University (SDC/SIHEC/2020/DIASDATA/0619-0320).

Data collection

Consecutive case records containing information about Bratthalls’s cariogram program data pertaining to both males and females were retrieved. Case records of patients age less than or equal to 60 years and patients records with history of physical and mental challenges were excluded. Subjecting to the selection criteria, a total of 524 patient records was obtained. On removing the duplicate and incomplete information case records; a final data of 283 patients records were entered and subjected to statistical analysis. The information on the percentage of chance to avoid new caries and percentage of circumstances (Decayed, Missing, Filled Surface (DMFS); medical conditions and medications that predispose to dental caries) were collected.

The Cariogram

The term “Cariogram” was coined by Douglas Bratthall in 1996 at the Dental School in Malmö University (Malmö, Sweden) to exhibit the interaction of various caries risk factors illustrated as a pie chart [43]. Cariogram is a software program developed to assess caries-risk clinically [44]. Clinical examination, diet frequency, history on systemic diseases and medication, fluoride programs, salivary pH and flow, total count of microorganisms (*S.mutans* and *Lactobacillus*) were assessed and scored according to the program developer instruction [45] This software ariogram the data and illustrates the results as a pie chart with five sectors, colored green, yellow, red, dark blue and light blue representing various caries risk factors [46]

Cariogram	
Sectors	Factors measured
Dark blue sector	Diet - combination of contents and frequency
Light blue sector	Susceptibility - combination of fluoride program, saliva secretion, and saliva buffer capacity
Red sector	Bacteria - combination of the plaque amount and the <i>S.mutans</i> (MS) count
Yellow sector	Circumstances - amalgamation of past caries experience and systemic diseases

Green sector	Estimated chance to avoid new caries
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Statistical analysis

Data was recorded in Microsoft Excel 2016 (Microsoft office 10) and later imported to the Statistical Package for Social Science (SPSS IBM version 20.0) for statistical analysis. Descriptive statistics and independent t test was employed with a level of significance set at $p < 0.05$.

RESULTS

The recorded mean age among the study population was 65.8 ± 5.1 years. Among 283 elderly patients; 62.19% were males and 37.81% were females [Figure 1]. The mean of circumstances sector among the males was 7.79 and among the females was 8.34. There found to be no significant difference in the mean circumstances sector between males and females ($P > 0.05$). However, females have had higher past caries experience (increased risk for caries) than males. [Figure 2]. The mean estimated chances to avoid new caries among males was 47.79 and females was 46.06. No significant difference in the mean chance to avoid new caries among males and females in the independent t test ($P > 0.05$). However, females have less chance to avoid new caries (more caries risk) compared to males [Figure 3]. About 95.76% of elderly patients had less than 20% of the circumstances sector and 4.24% had between 20%-40% of the circumstances sector. Most of the elderly had past caries experience [Figure 4]. About 18.73% of elderly patients had less than 20% of the estimated chance to avoid new caries, 19.79% of patients had between 20%-40%, 26.5% of patients had between 40%-60%, 24.03% of patients had between 60%-80% and 10.95% of patients had between 80%-100% of the estimated chance to avoid new caries. Most of the elderly patients have had moderate risk for caries [Figure 5].

DISCUSSION

The data for this retrospective study was based on residents of Chennai seeking treatment at private dental college, Chennai. Currently there is no existing studies investigating the green sector and the yellow sector of cariogram among elderly in the South Indian population. This study thus aims to shed light on the systemic diseases, past caries experience and the subsequent chance to avoid new caries in elderly patients.

One study conducted among young adults reported a significant correlation between caries risk and previous caries experience, previous and current fluoride programs, and *S. mutans* and *Lactobacillus* counts in unstimulated saliva [47]). Another study

found a statistical significant correlation between plaque amount, diet frequency and the chance to avoid new caries among children [48]

A study assessed the caries risk among school going children in the Puducherry population concluded that the mean actual chance to avoid new caries in high caries risk group and low caries risk group was statistically significant [49]). One study in consistency with the present study which assessed caries risk among elderly, established a statistical significant association between the chance to avoid new caries and past caries experience [50].

Another study which assessed the caries risk using a cariogram model found an increased incidence of caries among individuals with high caries risk than individuals with low caries risk in adults [51]. One other study exhibited a significant association of diet frequency, plaque amount and salivary secretion rate with increment of caries [52]. A study which assessed the caries risk using a cariogram model in a group of elderly individuals found that the mean decayed, missing and filled surfaces (DMFS) after a five year period was high among group of individuals with high caries risk (0% - 40% chance of avoiding new caries) when compared to group of individuals with low caries risk (61% - 100% chance of avoiding new caries) [53].

A Study among elderly concluded that the chance to avoid new caries (the green component) was lower in periodontitis patients when compared to patients with healthy gingiva [54]. It can be attributed to the fact that periodontal disease bacteria compensate for the cariogenic bacteria to maintain the oral microbial flora. A majority of highly cited literature shows significant association between past caries experience, systemic diseases and the chance to avoid new caries, thus being in agreement with the findings of the present study. The results of this study cannot be generalized to other elderly populations due to geographic and cultural variations. Further prospective studies are needed to examine the applications of cariogram programs to special high-risk groups such as the elderly population.

CONCLUSION

Within the limits of this study, a statistical significant association was found between the chance to avoid new caries and the circumstances in elderly patients. An awareness and education about caries preventive measures to be inculcated among the elderly population. A special consideration for preventive measures should be directed to the elderly population with chronic diseases such as Dementia and Alzheimers.

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AUTHORS CONTRIBUTION

Arthi Balasubramanian has contributed to the study conception and design, data collection, analysis, interpretation and drafted the work. Trishala.A has contributed to statistical analysis, data collection and data interpretation. All authors critically reviewed the manuscript and approved the final version.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- Prabakar J, John J, Srisakthi D. Prevalence of dental caries and treatment needs among school going children of Chandigarh. *Indian J Dent Res.* 2016 Sep;27(5):547–52.
- Prabakar J, John J, Arumugham IM, Kumar RP, Sakthi DS. Comparative Evaluation of the Viscosity and Length of Resin Tags of Conventional and Hydrophilic Pit and Fissure Sealants on Permanent Molars: An In vitro Study. *Contemp Clin Dent.* 2018 Jul;9(3):388–94.
- Prabakar J, John J, Arumugham I, Kumar R, Srisakthi D. Comparative evaluation of retention, cariostatic effect and discoloration of conventional and hydrophilic sealants - A single blinded randomized split mouth clinical trial [Internet]. Vol. 9, *Contemporary Clinical Dentistry.* 2018. p. 233. Available from: http://dx.doi.org/10.4103/ccd.ccd_132_18
- Kumar RP, Pradeep Kumar R, Vijayalakshmi B. Assessment of Fluoride Concentration in Ground Water in Madurai District, Tamil Nadu, India [Internet]. Vol. 10, *Research Journal of Pharmacy and Technology.* 2017. p. 309. Available from: <http://dx.doi.org/10.5958/0974-360x.2017.00063.4>
- Kannan SSD, Kumar VS, Rathinavelu PK, Indiran MA. AWARENESS AND ATTITUDE TOWARDS MASS DISASTER AND ITS MANAGEMENT AMONG HOUSE SURGEONS IN A DENTAL COLLEGE AND HOSPITAL IN CHENNAI, INDIA [Internet]. *Disaster Management and Human Health Risk V.* 2017. Available from: <http://dx.doi.org/10.2495/dman170121>
- Kumar RP, Pradeep Kumar R, Preethi R. Assessment of Water Quality and Pollution of Porur, Chembarambakkam and Puzhal Lake [Internet]. Vol. 10, *Research Journal of Pharmacy and Technology.* 2017. p. 2157. Available from: <http://dx.doi.org/10.5958/0974-360x.2017.00380.8>
- Samuel SR, Acharya S, Rao JC. School Interventions-based Prevention of Early-Childhood Caries among 3-5-year-old children from very low socioeconomic status: Two-year randomized trial. *J Public Health Dent.* 2020 Jan;80(1):51–60.
- Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial. *Clin Oral Investig.* 2020;1–6.
- Khatri S, Madan K, Srinivasan S, Acharya S. Retention of moisture-tolerant fluoride-releasing sealant and amorphous calcium phosphate-containing sealant in 6–9-year-old children: A randomized controlled trial [Internet]. Vol. 37, *Journal of Indian Society of Pedodontics and Preventive Dentistry.* 2019. p. 92. Available from: http://dx.doi.org/10.4103/jisppd.jisppd_173_18
- Pavithra RP, Jayashri P. Influence of Naturally Occurring Phytochemicals on Oral Health. *Research Journal of Pharmacy and Technology.* 2019;12(8):3979–83.
- Neralla M, Jayabalan J, George R, Rajan J, P SKM, Haque AE, et al. Role of nutrition in rehabilitation of patients following surgery for oral squamous cell carcinoma. *IJRPS.* 2019 Oct 16;10(4):3197–203.
- Prabakar J, John J, Arumugham I, Kumar R, Sakthi D. Comparing the effectiveness of probiotic, green tea, and chlorhexidine- and fluoride-containing dentifrices on oral microbial flora: A double-blind, randomized clinical trial [Internet]. Vol. 9, *Contemporary Clinical Dentistry.* 2018. p. 560. Available from: http://dx.doi.org/10.4103/ccd.ccd_659_18
- Mohapatra S, Kumar RP, Arumugham IM, Sakthi D, Jayashri P. Assessment of Microhardness of Enamel Carious Like Lesions After Treatment with Nova Min, Bio Min and Remin Pro Containing Toothpastes: An in Vitro Study. *Indian Journal of Public Health Research & Development.* 2019;10(10):375–80.
- Leelavathi L, Others. Nicotine Replacement Therapy for Smoking Cessation-An Overview. *Indian Journal of Public Health Research & Development* [Internet]. 2019;10(11).

- Available from: <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09760245&AN=141274498&h=gYL53PORTDuihXfEOqLsBmolOVY%2Fn1jwd7eokhNcHN%2F5g8CVaYKbt1wU4UOsqCY51fRbe6Ner1I6TkeG%2FuwDg%3D%3D&cr=c>
15. Pratha AA, Prabakar J. Comparing the effect of Carbonated and energy drinks on salivary pH- In Vivo Randomized Controlled Trial. *Research Journal of Pharmacy and Technology*. 2019;12(10):4699-702.
 16. Chifor I. SALIVA CHARACTERISTICS, DIET AND CARIORECEPTIVITY IN DENTAL STUDENTS [Internet]. Vol. 87, *Clujul Medical*. 2014. p. 34-9. Available from: <http://dx.doi.org/10.15386/cjm.2014.8872.871.ic1ib2>
 17. Hegde PP, Kumar BRA, Ankola VA. Dental caries experience and salivary levels of *Streptococcus mutans* and *Lactobacilli* in 13-15 years old children of Belgaum city, Karnataka [Internet]. Vol. 23, *Journal of Indian Society of Pedodontics and Preventive Dentistry*. 2005. p. 23. Available from: <http://dx.doi.org/10.4103/0970-4388.16022>
 18. Petersson GH, Isberg P-E, Twetman S. Caries risk assessment in school children using a reduced Cariogram model without saliva tests. *BMC Oral Health*. 2010 Apr 19;10:5.
 19. Saravanan S, Anuradha KP, Bhaskar DJ. Prevalence of dental caries and treatment needs among school going children of Pondicherry, India. *J Indian Soc Pedod Prev Dent*. 2003 Mar;21(1):1-12.
 20. Sonbul H, Al-Otaibi M, Birkhed D. Risk profile of adults with several dental restorations using the Cariogram model. *Acta Odontol Scand*. 2008;66(6):351-7.
 21. Sundell AL, Ullbro C, Marcusson A, Twetman S. Comparing caries risk profiles between 5- and 10- year-old children with cleft lip and/or palate and non-cleft controls [Internet]. Vol. 15, *BMC Oral Health*. 2015. Available from: <http://dx.doi.org/10.1186/s12903-015-0067-x>
 22. Tayanin GL, Petersson GH, Bratthall D. Caries risk profiles of 12-13-year-old children in Laos and Sweden. *Oral Health Prev Dent*. 2005;3(1):15-23.
 23. Rajeshkumar S, Kumar SV, Ramaiah A, Agarwal H, Lakshmi T, Roopan SM. Biosynthesis of zinc oxide nanoparticles using *Mangifera indica* leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells. *Enzyme Microb Technol*. 2018 Oct;117:91-5.
 24. Kavitha M, Subramanian R, Narayanan R, Udhayabanu V. Solution combustion synthesis and characterization of strontium substituted hydroxyapatite nanocrystals [Internet]. Vol. 253, *Powder Technology*. 2014. p. 129-37. Available from: <http://dx.doi.org/10.1016/j.powtec.2013.10.045>
 25. Vijayakumar GNS, Nixon Samuel Vijayakumar G, Devashankar S, Rathnakumari M, Sureshkumar P. Synthesis of electrospun ZnO/CuO nanocomposite fibers and their dielectric and non-linear optic studies [Internet]. Vol. 507, *Journal of Alloys and Compounds*. 2010. p. 225-9. Available from: <http://dx.doi.org/10.1016/j.jallcom.2010.07.161>
 26. Danda AK. Comparison of a single noncompression miniplate versus 2 noncompression miniplates in the treatment of mandibular angle fractures: a prospective, randomized clinical trial. *J Oral Maxillofac Surg*. 2010 Jul;68(7):1565-7.
 27. Lekha L, Kanmani Raja K, Rajagopal G, Easwaramoorthy D. Synthesis, spectroscopic characterization and antibacterial studies of lanthanide(III) Schiff base complexes containing N, O donor atoms [Internet]. Vols. 1056-1057, *Journal of Molecular Structure*. 2014. p. 307-13. Available from: <http://dx.doi.org/10.1016/j.molstruc.2013.10.014>
 28. Putchala MC, Ramani P, Herald J, Sherlin, Premkumar P, Natesan A. Ascorbic acid and its pro-oxidant activity as a therapy for tumours of oral cavity - A systematic review [Internet]. Vol. 58, *Archives of Oral Biology*. 2013. p. 563-74. Available from: <http://dx.doi.org/10.1016/j.archoralbio.2013.01.016>
 29. Devi VS, Subathra Devi V, Gnanavel BK. Properties of Concrete Manufactured Using Steel Slag [Internet]. Vol. 97, *Procedia Engineering*. 2014. p. 95-104. Available from: <http://dx.doi.org/10.1016/j.proeng.2014.12.229>
 30. Dhinesh B, Niruban Bharathi R, Isaac JoshuaRamesh Lalvani J, Parthasarathy M, Annamalai K. An experimental analysis on the influence of fuel borne additives on the single cylinder diesel engine powered by *Cymbopogon flexuosus* biofuel [Internet]. Vol. 90, *Journal of the Energy Institute*. 2017. p. 634-45. Available from: <http://dx.doi.org/10.1016/j.joei.2016.04.010>
 31. Danda AK, Tatiparthi MK, Narayanan V, Siddareddi A. Influence of Primary and Secondary Closure of Surgical Wound After Impacted Mandibular Third Molar Removal

- on Postoperative Pain and Swelling—A Comparative and Split Mouth Study [Internet]. Vol. 68, *Journal of Oral and Maxillofacial Surgery*. 2010. p. 309–12. Available from: <http://dx.doi.org/10.1016/j.joms.2009.04.060>
32. Gopalakannan S, Senthilvelan T, Ranganathan S. Modeling and Optimization of EDM Process Parameters on Machining of Al 7075-B4C MMC Using RSM [Internet]. Vol. 38, *Procedia Engineering*. 2012. p. 685–90. Available from: <http://dx.doi.org/10.1016/j.proeng.2012.06.086>
 33. Venu H, Dhana Raju V, Subramani L. Combined effect of influence of nano additives, combustion chamber geometry and injection timing in a DI diesel engine fuelled with ternary (diesel-biodiesel-ethanol) blends [Internet]. Vol. 174, *Energy*. 2019. p. 386–406. Available from: <http://dx.doi.org/10.1016/j.energy.2019.02.163>
 34. Adalarasan R, Santhanakumar M, Rajmohan M. Application of Grey Taguchi-based response surface methodology (GT-RSM) for optimizing the plasma arc cutting parameters of 304L stainless steel [Internet]. Vol. 78, *The International Journal of Advanced Manufacturing Technology*. 2015. p. 1161–70. Available from: <http://dx.doi.org/10.1007/s00170-014-6744-0>
 35. Parthasarathy M, Isaac Joshua Ramesh Lalvani J, Dhinesh B, Annamalai K. Effect of hydrogen on ethanol-biodiesel blend on performance and emission characteristics of a direct injection diesel engine. *Ecotoxicol Environ Saf*. 2016 Dec;134(Pt 2):433–9.
 36. Neelakantan P, Cheng CQ, Mohanraj R, Sriraman P, Subbarao C, Sharma S. Antibiofilm activity of three irrigation protocols activated by ultrasonic, diode laser or Er:YAG laser in vitro [Internet]. Vol. 48, *International Endodontic Journal*. 2015. p. 602–10. Available from: <http://dx.doi.org/10.1111/iej.12354>
 37. Sajjan D, Udaya Lakshmi K, Erdogdu Y, Joe IH. Molecular structure and vibrational spectra of 2,6-bis(benzylidene)cyclohexanone: a density functional theoretical study. *Spectrochim Acta A Mol Biomol Spectrosc*. 2011 Jan;78(1):113–21.
 38. Sharma P, Mehta M, Dhanjal DS, Kaur S, Gupta G, Singh H, et al. Emerging trends in the novel drug delivery approaches for the treatment of lung cancer. *Chem Biol Interact*. 2019 Aug 25;309:108720.
 39. Ranganathan H, Ganapathy DM, Jain AR. Cervical and Incisal Marginal Discrepancy in Ceramic Laminate Veneering Materials: A SEM Analysis. *Contemp Clin Dent*. 2017 Apr;8(2):272–8.
 40. Lekha L, Kanmani Raja K, Rajagopal G, Easwaramoorthy D. Schiff base complexes of rare earth metal ions: Synthesis, characterization and catalytic activity for the oxidation of aniline and substituted anilines [Internet]. Vol. 753, *Journal of Organometallic Chemistry*. 2014. p. 72–80. Available from: <http://dx.doi.org/10.1016/j.jorgchem.2013.12.014>
 41. Neelakantan P, Grotra D, Sharma S. Retreatability of 2 mineral trioxide aggregate-based root canal sealers: a cone-beam computed tomography analysis. *J Endod*. 2013 Jul;39(7):893–6.
 42. PradeepKumar AR, Shemesh H, Jothilatha S, Vijayabharathi R, Jayalakshmi S, Kishen A. Diagnosis of Vertical Root Fractures in Restored Endodontically Treated Teeth: A Time-dependent Retrospective Cohort Study. *J Endod*. 2016 Aug;42(8):1175–80.
 43. MacEntee MI. Oral Healthcare and the Frail Elder: A Clinical Perspective. *John Wiley & Sons*; 2010. 328 p.
 44. Featherstone JDB, Adair SM, Anderson MH, Berkowitz RJ, Bird WF, Crall JJ, et al. Caries management by risk assessment: consensus statement, April 2002. *J Calif Dent Assoc*. 2003 Mar;31(3):257–69.
 45. Zukanović A, Kobaslija S, Ganibegović M. Caries risk assessment in Bosnian children using Cariogram computer model. *Int Dent J*. 2007 Jun;57(3):177–83.
 46. Bratthall D, Hänsel Petersson G. Cariogram—a multifactorial risk assessment model for a multifactorial disease. *Community Dent Oral Epidemiol*. 2005 Aug;33(4):256–64.
 47. Peker I, Mangal T, Erten H, Alp G, Avci E, Akca G. Evaluation of caries risk in a young adult population using a computer-based risk assessment model (Cariogram) [Internet]. Vol. 7, *Journal of Dental Sciences*. 2012. p. 99–104. Available from: <http://dx.doi.org/10.1016/j.jds.2012.03.004>
 48. Dias KR, de Andrade CB, de Almeida Wait TT, Chamon RC, dos Santos KRN, Soviero VM, et al. Influence of the microbiological component of Cariogram® for evaluating the risk of caries in children [Internet]. Vol. 75, *Acta Odontologica Scandinavica*. 2017. p. 446–52. Available from: <http://dx.doi.org/10.1080/00016357.2017.1334960>
 49. Hebbal M, Ankola A, Metgud S. Caries risk profile of 12 year old school children in an Indian city using Cariogram [Internet].

- Medicina Oral Patología Oral y Cirugía Bucal. 2012. p. e1054–61. Available from: <http://dx.doi.org/10.4317/medoral.17880>
50. Alian AY, McNally ME, Fure S, Birkhed D. Assessment of caries risk in elderly patients using the Cariogram model. *J Can Dent Assoc.* 2006 Jun;72(5):459–63.
 51. Dou L, Luo J, Fu X, Tang Y, Gao J, Yang D. The validity of caries risk assessment in young adults with past caries experience using a screening Cariogram model without saliva tests. *Int Dent J.* 2018 Aug;68(4):221–6.
 52. Celik EU, Gokay N, Ates M. Efficiency of caries risk assessment in young adults using Cariogram. *Eur J Dent.* 2012 Jul;6(3):270–9.
 53. Petersson GH, Fure S, Bratthall D. Evaluation of a computer-based caries risk assessment program in an elderly group of individuals [Internet]. Vol. 61, *Acta Odontologica Scandinavica.* 2003. p. 164–71. Available from: <http://dx.doi.org/10.1080/00016350310002261>
 54. Raju SK, Fareed N, Sudhir KM, Krishna Kumar RVS. Caries risk assessment among subjects with periodontal disease using cariogram study model [Internet]. Vol. 14, *Journal of Indian Association of Public Health Dentistry.* 2016. p. 266. Available from: <http://dx.doi.org/10.4103/2319-5932.189838>

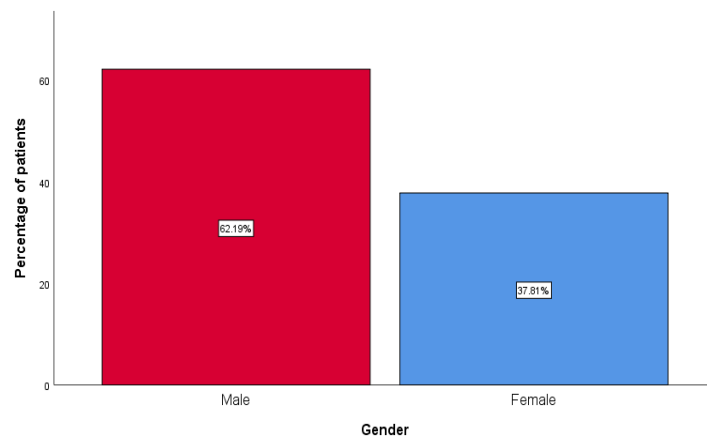


Figure 1 : Bar graph representing gender distribution. X axis represents the gender and Y axis represents the percentage of elderly patients included in this study. 62.19% were males (Red) and 37.81% were females (Blue).

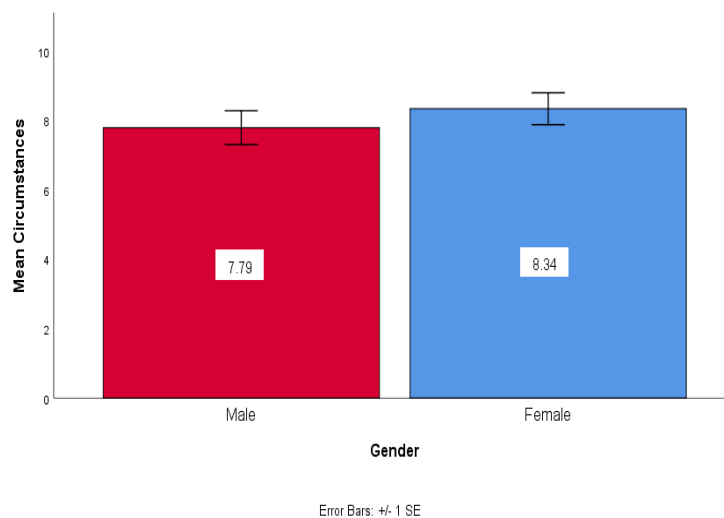


Figure 2 : Bar chart with error bars representing the mean distribution and mean comparison of circumstances among males and females. X axis represents the gender and Y axis represents the mean circumstances. The mean past caries experience of males (Red) was 7.79 and of females (Blue) was 8.34. No significant difference observed ($P > 0.05$). However, females have higher past caries experience (increased risk for caries) than males.

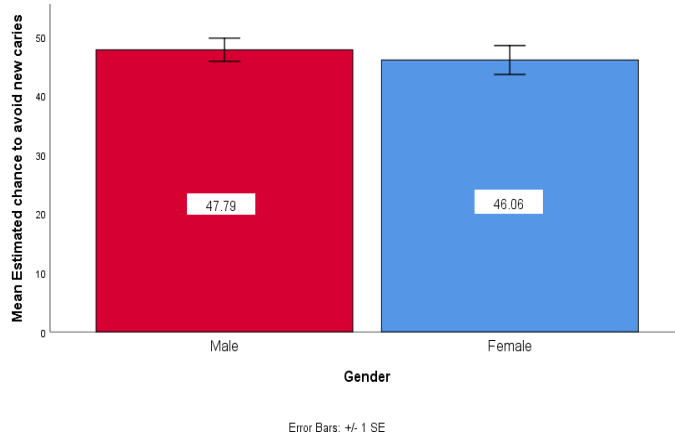


Figure 3 : The bar chart with error bars represents the mean distribution and mean comparison of estimated chance to avoid new caries among males and females. X axis represents the gender and Y axis represents the mean estimated chance to avoid new caries. No significant difference in the mean chance to avoid new caries among males and females in the independent t test ($P>0.05$). However, females have less chance to avoid new caries (more caries risk) compared to males.

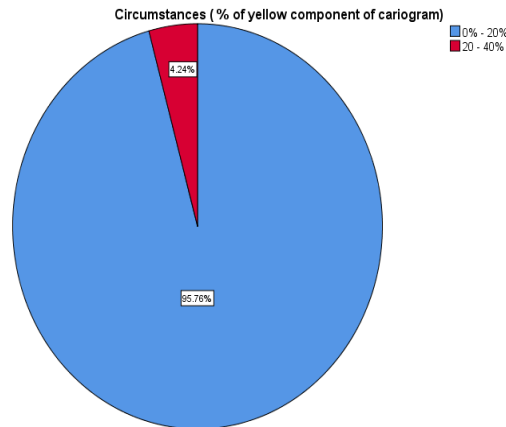


Figure 4 : The pie chart represents the distribution of the circumstances sector for caries risk among the elderly patients. 95.76% of elderly had 0%-20% of past caries experience (blue) and 4.24% of elderly had 20-40% of past caries experience (red).

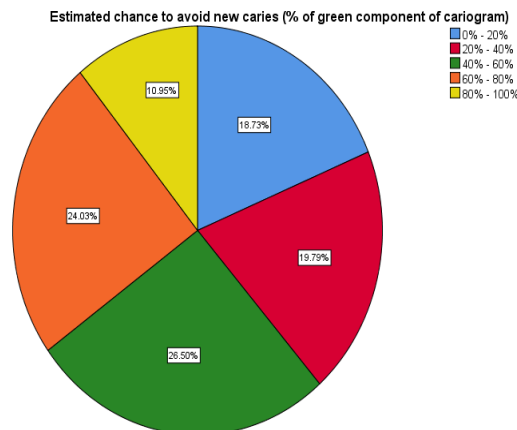


Figure 5 : Pie chart representing the distribution of the estimated chance to avoid new caries among elderly patients. 18.73% of elderly had 0%-20% (blue), 19.79% of elderly had 20-40% (red), 26.50% of elderly had 40-60% (green), 24.03% of elderly had 60-80% (yellow) of chance to avoid of new caries.