Impact of dietary intake on periodontitis and tooth loss. A cross sectional Study on diabetic and non-diabetic patients.

[1]Dr. Neetu Kadu, [2]Farzeen Ansari, [3]Madiha Khan, [4]Insharah Sayyed, [5]Dr. Renuka Nagarale,

[1]Reader, [2,3,4] Student, [5]Professor
[1,2,3,4,5]Department of Public Health Dentistry
[1,2,3,4,5]M.A Rangoonwala College of Dental Sciences and Research Centre, Pune, India.
1researchcouncil24@gmail.com , [2]farzeenansari2112@gmail.com , [3]khanmadiha457@gmail.com, [3]sayyedinsharah@gmail.com , [5]renukagn.g@gmail.com

***Abstract*—**

Aim - This study explores the impact of dietary intake on periodontitis and tooth loss among 114 diabetic and non-diabetic adults.

Materials and Methods - Participants' dietary habits were assessed using a validated Food Frequency Questionnaire (FFQ) developed with a dietitian, categorizing diets as anti-inflammatory, moderately inflammatory, or pro-inflammatory. Periodontal health was evaluated using Russell's Periodontal Index, with scores revealing disease severity.

Results – It was demonstrated that participants on anti-inflammatory diets had significantly lower periodontal disease severity, while those consuming pro-inflammatory diets showed higher scores on Russell's Index ($p<0.05$). Diabetic participants experienced more severe periodontitis and greater tooth loss, with dietary patterns further influencing outcomes. Socioeconomic factors showed no significant impact on periodontal status.

Conclusion - These findings suggest that diet plays a vital role in periodontal health, particularly among diabetic individuals, highlighting the potential for dietary interventions in preventive dental care. Further studies are warranted to expand on these associations.

***Index Terms*—**Periodontitis, dietary intake, diabetes, anti-inflammatory diet, tooth loss *(key words)*

I. Introduction

Periodontitis, a prevalent infectious disease affecting millions globally, results in inflammation of the supporting tissues of the teeth and progressive attachment and bone loss [(1)]. This chronic inflammatory condition can lead to tooth mobility and eventually its loss [(2)].

Its etiology is multifactorial, encompassing microbial, genetic, environmental, and age related factors, with dietary intake playing a crucial role in its development and progression [(3)]. Notably, periodontitis affects approximately 11.2% of the global population [(4)].

The interplay between diet and oral health has been well established; diets high in sugars and refined carbohydrates contribute to dental caries and periodontal disease, while those rich in fruits, vegetables, and essential nutrients correlate with improved periodontal health [(5,6)] Nutrients such as vitamin C, vitamin D, and omega-3 fatty acids are particularly vital due to their anti-inflammatory properties and roles in immune function [(7)].

Additionally, diabetes, characterized by chronic hyperglycemia, exacerbates periodontal disease, creating a bidirectional relationship where periodontitis can negatively impact glycemic control [(8)] given this intricate connection, it is essential to investigate how dietary habits influence periodontal health among both diabetic and non-diabetic individuals.

This cross-sectional study aims to explore the impact of dietary intake on periodontitis and tooth loss among diabetic and non-diabetic patients. By analyzing dietary patterns and their association with periodontal health in these groups, this research seeks to identify potential nutritional interventions to mitigate the risk of periodontitis and tooth loss, particularly for individuals with diabetes.

Understanding these relationships is crucial for developing dietary guidelines that enhance both oral health and glycemic control in diabetics. Furthermore, the study will consider socioeconomic and lifestyle factors influencing dietary choices, such as access to nutritious foods and health literacy [(9,10)].

II. Methodology

Study Design and Participants

After obtaining approval from the Institutional research and ethical committee (Ref. No: EC/MCES/970/2024), this cross-sectional study was conducted to assess the impact of dietary intake on periodontitis and tooth loss among diabetic and non-diabetic patients. The study was carried out at M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune. Participants were recruited from the outpatient department based on predetermined inclusion criteria after giving them the information about the study (Annexure 3). Adults over 30 years of age, who consented to participate and were willing to provide dietary information, were included. Patients with systemic diseases other than diabetes or on any other medications were excluded. Study Sample size was determined using the formula: $N = [(Z\alpha)2 * p(1-p)]/d2$ Where: $(Z\alpha) = 1.96$ (for a 95% confidence level), $p = 8.09\%$ (prevalence of periodontal disease), $1-p = 100 – 8.09 = 91.91\%$, $d = 5\%$ (margin of error). Substituting these values, a final sample size of 114 participants was determined.

Data Collection

Data Collection includes demographic details, socio economic status, Food Frequency Questionnaire (24 questions) (Annexure 1) and Russell's periodontal Index. The Food Frequency Questionnaire (FFQ) was meticulously developed in collaboration with a dietitian to evaluate participants' dietary intake, particularly focusing on foods with potential inflammatory properties (Annexure 2). A pilot study among 20 participants helped us to determine the reliability of the questionnaire and confirmed its validity, resulting in a strong Cronbach's alpha of 0.812. The responses were systematically analyzed by the same dietitian, with scores assigned to each response based on a scale of 1 to 3, corresponding to the numbered options in the questionnaire. Participants with a total score between 20-35 were categorized as having an anti-inflammatory diet, those scoring 36-45 were classified as following a moderately inflammatory diet, and scores ranging from 46-66 indicated a pro - inflammatory diet.

Russell's Periodontal Index – (Annexure 2)

To assess the severity of periodontal disease, clinical examinations were conducted using Russell's Periodontal Index [(11)]. Each participant underwent a thorough oral examination, and their periodontal condition was scored according to the index's criteria, which range from 0 (no disease) to 5(severe periodontal involvement). This method provided a standardized measure of the participants' periodontal status, enabling the classification of disease severity and also gives us the number of tooth loss.

Statistical Analysis

Data collected from the Food Frequency Questionnaire (FFQ) and clinical assessments using Russell's Periodontal Index was systematically entered into Microsoft Excel and statistical analysis was done. Descriptive statistics were utilized to summarize demographic information, dietary scores, and periodontal health outcomes. To explore associations between dietary intake, diabetes status, and periodontal disease severity, inferential statistics were applied. Statistical analyses were performed using SPSS software version 23.0, maintaining a 95% confidence interval and a study power of 80%. Results are presented in tabular form.

III. **RESULT**

TABLE 1: DEMOGRAPHICS OF THE STUDY POPULATION

Variables		
Mean Age (in years)	49.56 ± 10.75	
Gender	Male	59
	Female	55
Education	Below high school	88
	Above high school	26
Income	Below 10000	84
	Above 10000	30
Diabetic status	Non-Diabetic	58
	Diabetic	56
Total	114	

TABLE 2: COMPARISON OF DIET SCORE WITH DIFFERENT PARAMETERS

Diet score	Age		Gender		Education		Income		Diabetic		Total
	Mean	SD	Male	Female	<High School	>High School	<10000	>10000	Absent	Present	
20-35	49.2	10.75	45	34	60	19	59	20	34	45	79
36-45	50.83	12.77	9	14	18	5	17	6	23	0	23
46-66	49.5	6.17	5	7	10	2	8	4	1	11	12
p-value	0.984		0.002*		0.364		0.329		0.001*		114

*p<0.05; significant

TABLE 3: COMPARISON OF TOOTH LOSS WITH DIFFERENT PARAMETERS

Tooth loss	Age		Gender		Education		Income		Diabetic		Total
	Mean	SD	Male	Female	<High School	>High School	<10000	>10000	Absent	Present	
0 to 4	48.31	7.92	24	21	33	12	33	12	33	12	45
5 to 10	50.41	12.43	34	30	50	14	48	16	24	40	64
>10	50	10.65	1	4	5	0	3	2	1	4	5
p-value	0.607		0.348		0.389		0.495		0.001*		114

*p<0.05; significant

TABLE 4: COMPARISON OF RUSSELL'S INDEX SCORE WITH DIFFERENT PARAMETERS

Russell's index	Age		Gender		Education		Income		Diabetic		Total
	Mean	SD	Male	Female	<High School	>High School	<10000	>10000	Absent	Present	
2	47.76	7.66	24	22	33	13	34	12	34	12	46
3	51	13.69	26	25	40	11	38	13	24	27	51
4	50.12	7.06	9	8	15	2	12	5	0	17	17
p-value	0.348		0.988		0.368		0.063		0.001*		114

TABLE 5: COMPARISON OF RUSSELL'S INDEX WITH TOOTH LOSS AND DIET SCORE

Russell's index	Diet score			Tooth loss			Total
	20-35	36-45	46-66	0 to 4	5 to 10	>10	
2	34	12	0	44	2	0	46
3	39	11	1	1	48	2	51
4	6	0	11	0	14	3	17
p-value	0.001*			<0.001*			114

TABLE 6: COMPARISON OF TOOTH LOSS WITH DIET SCORE

Tooth loss	Diet score			Total
	20-35	36-45	46-66	
0 to 4	33	12	0	45
5 to 10	43	11	10	64
>10	3	0	2	5
p-value	0.171			114

Table 1 shows that mean age of study participants was 49.56 ± 10.75 years and out of total 114 participants 59 were male and 55 were female and a total of 56 participants reported having diabetes. From table 2 it was observed that 79 patients had diet score in between 20-35 indicating anti-inflammatory diet, 23 patients had diet score in between 36-45 indicating moderately inflammatory diet and 12 patients had score ranging from 46-66 representative of pro-inflammatory diet. In Table 2 when diet score ranges distribution were compared in various parameters it was noted that only gender and diabetic status had significant differences ($p<0.05$).
Table 3 shows that Tooth loss was categorized into three categories ranging from 0-4 tooth loss, 4-10 and more than 10. The comparison of distribution of tooth loss with age, gender, education, income was found insignificant whereas diabetic status had a significant difference and maximum diabetic patients had moderate tooth loss (n=40 and $p<0.05$; significant). Similarly, for Russel's index out of total 114, 46 showed simple gingivitis, 51 had beginning of destructive periodontal diseases and 17 had established periodontal diseases and except diabetic status remaining parameters showed insignificant comparisons. (Table 4).

Table 5 shows the comparison between Russel's index score and diet score as well as tooth loss. It was seen that out of 12 patients who had diet score in between 46-66 (pro-inflammatory) 11 had advanced periodontal disease and 1 had beginning of destructive periodontal diseases whereas patients who had good diet had better periodontal health status with less Russel's index score and this difference was statistically significant ($p<0.05$). Similarly, patients who had higher tooth loss also had higher Russel's index and this was also statistically significant ($p<0.05$). From table 6 it was observed that there was no significant association between diet score and tooth loss ($p>0.05$).

IV. DISCUSSION :-

Dietary intake, particularly the consumption of foods rich in sugars and refined carbohydrates, has long been implicated in the progression of periodontal disease [(12)]. Diets high in these inflammatory components lead to elevated systemic inflammation, worsening inflammatory responses in periodontal tissues also in contrast, diets rich in anti-inflammatory nutrients such as omega-3 fatty acids, vitamins C and D, and antioxidants have been associated with improved periodontal health outcomes [(13)].

In this study, results showed that participants adhering to an anti-inflammatory diet demonstrated significantly better periodontal health compared to those consuming pro-inflammatory diets which is statistically significance ($p < 0.005$). This aligns with findings by Vanessa M. et al. [(14)], who reported that individuals on an anti-inflammatory diet are more likely to present lower periodontal measures.
The result also showed a significant difference ($p < 0.001$), where diabetic participants exhibited more severe forms of periodontitis, as measured by Russell's Periodontal Index [(11)], compared to their non-diabetic counterparts. This finding aligns with the work of Jei Feng et al. [(15)], which highlights that, in the presence of diabetes, diet-induced periodontal conditions tend to worsen.

Tooth loss, often a consequence of advanced periodontal disease, was also examined in this study. Diabetic participants, particularly those consuming pro-inflammatory diets, exhibited higher incidences of tooth loss (5–10 or more teeth) compared to non-diabetic participants. This supports the established link between chronic inflammation, poor glycemic control, and periodontal tissue destruction, as demonstrated in research by Nishida M. et al. [(16)].

In this study, socioeconomic factors showed insignificant results in relation to tooth loss, diabetes, and periodontal status, in contrast to existing literature by Russell A.L. [(17)], which highlights the impact of socioeconomic status and health literacy on dietary choices. Lower-income individuals often face barriers to accessing nutrient-rich foods, leading to increased reliance on cheaper, processed, and inflammation-inducing options, as reported by the U.S. Department of Health and Human Services [(18)].

The limitations of this study include its cross-sectional design, which restricts causal inferences. Future longitudinal studies are needed to establish the long-term effects of dietary interventions on periodontal health. Additionally, self-reported dietary data may be subject to recall bias, though the Food Frequency Questionnaire's high Cronbach's alpha mitigates this concern. Nonetheless, this study contributes to the growing evidence suggesting that dietary modifications, particularly for diabetic individuals, can significantly influence periodontal outcomes.

This study's strengths include the use of both dietary assessments and clinical measures, ensuring a robust evaluation of diet's impact on periodontal health. The use of Russell's Periodontal Index enhances data accuracy, and the inclusion of socioeconomic factors provides a comprehensive understanding of determinants influencing periodontal outcomes.

V. CONCLUSION :-

In conclusion, the findings of this study underscore the critical role of dietary intake in the development and progression of periodontitis, particularly among individuals with diabetes. By emphasizing the importance of anti-inflammatory diets, clinicians can potentially improve both oral health and glycemic control in these at-risk populations. The integration of dietary counseling into routine dental care, especially for diabetic patients, may serve as a valuable strategy for preventing and managing periodontitis.

VI. EVALUATION PROFORMA

Demographic Data -

a) Name
b) Age
c) Gender
d) Occupation

Socio-economic status -

a) Education
b) Occupation
c) Monthly income of the Family

QUESTIONNAIRE (Annexure 1) -

a) Have you been diagnosed with diabetes?
   1. No 2. Yes
b) For diabetics - For how long have you been diagnosed with diabetes? _____
c) For diabetics - What are your recent test results of RBG and RBG-F? _____
d) For diabetics - Are you taking any medication for diabetes currently?
   1. Yes. 2. No
e) What type of diet do you consume?
   1. Combined 2. Veg 3. Non - Veg
f) Do you consume hard or soft diet?
   1. Soft diet. 2. Both. 3. Hard diet
g) Have you experienced any significant weight loss in the last six months?
   1. No 2. Yes
h) If yes, what was the reason of the weight loss? _____
i) How many times do you brush your teeth every day?
   1. More than twice 2. Twice 3. Once
j) When do you brush your teeth after waking up?
   1. Immediately 2. Sometime 3. After breakfast/tea
k) What method do you use to brush your teeth every day?
   1. Combined 2. Horizontal 3. Vertical
l) What material do you use while brushing?
   1. Fluoridated toothpaste 2. Non – fluoridated toothpaste 3. Powder substances
m) How many glasses of water do you drink in a day?
   1. 10 or more 2. 5 to 10 glasses 3. 0 to 5 glasses
n) What do you usually consume in Lunch and dinner?
   1. Combined diet 2. Protein rich diet. 3. Carbohydrate rich diet
o) Do you prefer any snacks in between meals? 1. No 2. Yes
p) If yes, what snacks do you usually consumed?
   1. Combined diet 2. Protein rich diet. 3. Carbohydrate rich diet
q) How frequently do you consume sugar in a day?
   1. Less than twice. 2. 2 to 5 times 3. More than 5 times
r) Which type of sugar do you usually consume?
   1. Jaggery 2. Brown sugar. 3. White sugar.
s) Do you take any citrus fruits in your diet?
   1. Sometimes. 2. Always 3. Never
t) How often have you consumed salads in your diet?
   1. Sometimes. 2. Always 3. Never
u) How often do you consume fried items?
   1. Never. 2. Sometimes 3. Always
v) Are there any starchy foods like rice and potatoes in your diet?
   1. Sometimes. 2. Always 3. Never
w) How often have you consumed spicy foods?
   1. Sometimes. 2. Always 3. Never
x) Do you practice any exercise or any other routine every day?
   1. Yes. 2. Sometimes. 3. No

INTRA ORAL EXAMINATION USING RUSSEL'S PERIODONTAL INDEX (Annexure 2)–

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

Calculation :- Sum of Individual score/No of teeth present
=_____
Result- _____

INFORMATION SHEET AND CONSENT FORM (Annexure 3)-

INFORMATION SHEET

We, the students of M. A. Rangoonwala Dental College and Research Centre, are conducting a
Study on the Impact of dietary intake on periodontitis and tooth loss.
A full mouth periodontal examination (FMPE) to collect periodontal measurement of all teeth except
Third molar will be done followed by a validated questionnaire to record dietary intake.
The study would be beneficial on an individual level and well as for future researches.
Your participation would be highly encouraged and appreciated.

CONSENT FORM

TITLE: Impact of dietary intake on periodontitis and tooth loss among diabetic and non-diabetic patients. A cross sectional study.

PARTCIPANT:
I confirm that Madiha Khan and Farzeen Ansari (investigators) have explained to me the purpose of
Research, the procedure and that there will be no intervention done on me and there will be no risk
That I may experience. All my queries regarding the study are made clear.I consent to Participate in the study.
NAME
AGE
GENDER
DATE
SIGNATURE

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