

# Prevalence of Xerostomia and Associated Risks Factors Among Medically Compromised Persons

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## Abstract

**Objective:** This study aimed to establish the prevalence of xerostomia and identify the risk variables related with oral manifestations among medically impaired patients. **Sample:** The study included 500 patients with medical conditions who were admitted to hospitals and specialised medical centres. Both males and females were included, and their ages ranged from 16 to 65 years. **The Method:** employed for diagnosing and investigating xerostomia involved the use of sialometry to measure stimulated and unstimulated saliva, along with a questionnaire that gathered sociodemographic information and assessed oral manifestations such as fissured lips and tongue with candida infection. Additionally, indices such as OHI-S, DMFT, and CPITN were used to evaluate oral health, and information on medical history, dietary behaviours, dental visits, and oral hygiene measures was collected. **Outcome:** The incidence of xerostomia among 500 patients was found to be 63.4%.The majority of individuals were female, aged between 55 and 85 years, with low levels of education, and residing in rural areas. The patients in this study exhibited a range of health issues, including diabetes mellitus, smoking, poor oral hygiene (as indicated by a score of 3 on the OHI index), and periodontal disease (with pockets measuring 6 mm or more on the CPITN index). They also had a high number of decayed, missing, and filled teeth (DMFT index of 20-25) and were taking more than 5 different medications. These patients experienced difficulties with eating, speaking, swallowing, and reported a burning sensation in their mouths. They had not visited a dental clinic, did not use artificial saliva, and were taking various medications including anti-histamines, anti-depressants, anti-hypertensives, anti-cholinergics, anti-epileptics, appetite supplements, bronchodilators, and decongestants. Additionally, they exhibited oral manifestations such as fungal infections. There was a strong correlation between the presence of cracked lips and tongue and the severity of dry mouth. **Conclusion:** Older females with poor educational levels residing in rural areas had a higher likelihood of experiencing xerostomia. However, there was no significant correlation found between the frequency of dental flossing or the kind of mouthwash used and the occurrence of xerostomia.This study primarily involved participants who were predominantly afflicted with diabetes mellitus, renal and hepatic disorders. These individuals experienced varying degrees of dry mouth, ranging from moderate to severe. The study revealed a noteworthy correlation between xerostomia and poor oral hygiene, as indicated by the OHI index. Additionally, there were substantial associations observed between xerostomia and other oral health indicators such as CPITN and DMFT index, candida infection, fissure tongue, and dry lips. Utilising precise technical procedures to identify and investigate underlying causes is more effective in achieving improved prevention and treatment.

**Keywords:** Xerostomia, Diabetes, OHI index, CPITN index, DMFT index.

## INTRODUCTION

Xerostomia is a condition characterised by a reduced production of saliva, resulting in a sensation of dryness in the mouth. Nevertheless, patients may experience xerostomia despite the absence of a measurable reduction in salivary volume. Xerostomia is a subjective problem characterised

by the impression of dryness in the mouth, which is an often experienced and bothersome condition. Salivary hypofunction is an objective medical disorder.<sup>[1]</sup> Insufficient

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salivary secretion can result in xerostomia, oral paresthesia, dysphagia, and diminished gustatory perception.<sup>[2]</sup>

Dry mouth is characterised by various symptoms, including cracked and peeled atrophic lips, cervical or cusps caries, glossitis, and corrugated pale buccal mucosa. Xerostomia may result in dysphagia, oral discomfort, dental caries, dysgusia, oral infection, and periodontitis.<sup>[3-6]</sup>

Xerostomia may be associated with malnutrition and psychosocial impairments. There are several factors that might induce dry mouth, including psychological factors, systemic disorders, the anticholinergic effects of some medications, alcohol consumption, and radiotherapy.<sup>[7]</sup> Xerostomia is the result of multiple circumstances. However, it predominantly occurs as an adverse effect of medication, as a consequence of head and neck radiation therapy, or as a manifestation of Sjogren syndrome. The salivary gland function can be impaired and result in dryness of the mouth due to the use of many medications, depending on the dosage and quantity of drugs taken. This may elucidate the reason for the frequent occurrence of mouth dryness in the elderly, due to the augmented utilisation of pharmaceuticals and the high prevalence of concurrent disorders.<sup>[8]</sup>

Xerostomia refers to the medical condition of having a dry mouth. This syndrome commonly arises in the majority of people who get radiation therapy for head and neck tumours, particularly when the primary salivary glands are exposed to radiation. After receiving a dose of 25 to 30 Gy of regular fractionated radiation therapy, the production of saliva usually drops by around 50 to 60 percent within the first week. This decrease reaches its lowest point after two to three weeks. The loss in salivary function is contingent upon the quantity and dosage of salivary gland tissue present in the irradiated region. Regrettably, the restoration of salivation typically does not occur prior to radiation therapy. Villa A *et al.*<sup>[9]</sup> discovered that the probability of recovery decreased when the average radiation dosage to the parotid gland exceeded 24 to 26 Gy. On the other hand, doses below this threshold were linked to a higher chance of experiencing significant recovery.<sup>[9]</sup>

Additional factors contributing to dry mouth encompass autoimmune conditions such systemic lupus erythematosus (SLE), rheumatoid arthritis (RA), thyroid disorders, and primary biliary cirrhosis (PBC), as well as a past habit of breathing via the mouth and inadequate water. Individuals with uncontrolled diabetes and neuropathy are susceptible to harm caused by head or neck traumas, end-stage renal disease (ESRD), graft-versus-host disease (GVHD), and HIV/AIDS.<sup>[10]</sup> The prevalence of xerostomia in diabetic individuals ranges from 14% to 62%, whereas in autoimmune thyroid illness it is 15%, and in HIV (human immunosuppressive virus) it is predicted to be between 1.2% and 40%. The prevalence of HCV infection ranged from 5% to 55% in patients. Additionally, the occurrence rate of xerostomia in individuals with systemic erythematosis was 75%. The prevalence of xerostomia ranged from 28% to 59% in patients with renal illness. Subsequently, the percentage was 48% among patients undergoing chemotherapy.<sup>[11-19]</sup> When it comes to assessing xerostomia, sialometry is a valuable and effective method. It

involves measuring the amount of saliva produced, specifically the unstimulated salivary flow rate of 0.3 ml/min and the stimulated salivary flow rate of 0.4-1.5 ml/min when using citrus acid. Imaging approach offers a highly effective means to accurately detect the specific issue in the salivary glands that is producing xerostomia and evaluate its performance. Sialography is a procedure that involves the use of a radiopaque injectable substance to examine and diagnose obstructions caused by salivary stone masses. Sodium pertechnetate has been employed in scintigraphy to evaluate salivary gland function, whereas biopsy is utilised to examine small salivary gland enlargement or malignancy. Additionally, ultrasound is utilised to diagnose sialolithiasis.<sup>[20]</sup>

The melanoma nursing initiative classifies xerostomia as three stages. Grade 1 is defined by the presence of symptoms such as thick or dry saliva, without any changes in diet. The salivary flow rate, evaluated using the sialometry method, is greater than 0.2 ml/min even when saliva is not stimulated. Grade 2 is characterised by moderate symptoms such as the usage of lubricants, a diet confined to purees and soft food, and an unstimulated salivary flow rate ranging from 0.1-0.2ml/min. Grade 3 patients are unable to consume food orally due to difficulty in swallowing, and instead rely on tube feeding or parenteral nourishment. In these patients, the unstimulated salivary flow rate is less than 0.1 ml/min.<sup>[21]</sup> A study conducted in Norway in 2008 found that pilocarpine tablets were effective in managing xerostomia in medically impaired patients. These tablets promote saliva secretion and alleviate the symptoms associated with dry mouth. Furthermore, a study conducted in the United States in 2012 shown the superior effectiveness of cevimilene over pilocarpine in treating xerostomia, while also causing fewer adverse effects.<sup>[22,23]</sup> The treatment aims to alleviate symptoms, while achieving complete resolution is typically not attained. Primary care involves providing patients with information on maintaining regular hydration and reducing tobacco consumption, as well as implementing local interventions such using artificial saliva. If local interventions prove ineffective, pharmaceutical treatment, typically utilising pilocarpine, is employed.<sup>[24]</sup>

## MATERIALS AND METHODS

### Study Participants

Patients diagnosed with xerostomia, who attended the outpatient clinics of the specialised medical centre at Aldiwaniyah hospital, were invited to participate in the study. The objective and significance of the study, as well as the value of their participation, were elucidated to both the participants and the parents of the children involved in this study. Following the reading of the participant information sheet, all individuals were requested to provide their signature on a consent form. All participants were provided with a clear explanation of the study objectives, and strict confidentiality was guaranteed. The study gained ethical approval from the hospital's local authority. A total of 500 participants, comprising both males and females aged between 16 and 84 years, were selected from Aldewaniyah hospital and specialised medical centres to participate in the study.

## Materials

- 1-Disposable mirror.
- 2-Disposable probe.
- 3-CPITN probe.
- 4-Gloves.
- 5-Masks.
- 6- Graduated disposable tube.
- 7-Disposable cups.
- 8-Sugerless gum

## Study Design

Across sectional study was involved in this research. It had been done from (to) in wich 8-10 patients were examined per day. Patients were suffering from diabetes mellitus, renal disease, stroke, sjogren syndrome, rheumatic arthritis, hepatitis, HIV, AIEDS and diarrhea or dehydration are targets of our research.

## Method

It was consisted of three parts

- 1- Questionnaire.
- 2- Saliva collection.
- 3-. Dental examination
- 4-Dental treatment

## The Study Questionnaire

All participants were requested to fully cooperate in answering all questions in the study questionnaire, which has two parts. The initial section comprises sociodemographic details such as the patient's name, gender, age, place of residence, educational attainment, and an evaluation of their oral health condition. The second portion pertains to the medical history of the participants, including any systemic disorders they may have, as well as inquiries about their medical habits such as alcohol consumption, smoking, oral hygiene practices like teeth brushing, mouth cleaning, and flossing, visits to the dental clinic, usage of fluoride and gum chewing, water consumption, and types of medication used. The researcher (WJ) recorded the questionnaires with English language material to prevent errors and ensure that all questions would be answered.

## Saliva Collection

The techniques for collecting stimulated and unstimulated salivary gland secretions were conducted using the methods described by Heintze<sup>[25]</sup> and O'Sullivan and Curzon<sup>[26]</sup>. The patient was seated in an upright position on a chair. Patients were advised to abstain from consuming food, beverages, or chewing for a minimum of two hours before collecting saliva. The participants were instructed to assume an erect posture on the chair and remain in a state of relaxation for a brief while. Unstimulated saliva was obtained by instructing the patient to spit into a disposable cup or clean container for one minute. The saliva was then collected into a graduated tube and quantified. Stimulate saliva production by instructing the patient to start chewing sugarless gum for one minute. Within the initial 10-second period, saliva was disposed of, followed by its collection by telling the participant to expel saliva into a container for a duration of one minute. Subsequently, the saliva was gathered into a graduated tube for measurement. If the unstimulated saliva value exceeded 0.2ml/min, it showed mild xerostomia. If the value ranged between 0.1-0.2ml/min, it indicated moderate xerostomia. Lastly, if the value was less than 0.1 ml/min, it indicated severe dry mouth.<sup>[27]</sup>

## Dental Examination

The dental examination was conducted using visual and tactile assessments. The assessments were conducted with single-use mirrors, single-use probes, and CPITN probes in natural daylight while seated on a standard chair. The chosen participants in this study all experienced xerostomia, a disorder characterised by dry mouth. The objective was to investigate the oral symptoms and consequences associated with xerostomia, namely the status of dental caries, oral hygiene, and periodontal condition. The caries status was assessed using the Decay-Missing-Filled index (DMFT) in accordance with the basic oral health survey procedures outlined by the World Health Organisation in 1997.<sup>[28,29]</sup> The Community Periodontal Index of Treatment Needs (CPITN) assessed periodontal conditions using a CPITN probe.<sup>[30]</sup> The assessment of oral hygiene state was conducted using the Oral Hygiene Index-Simplified (OHI-S), which includes both the Debris Index (DI) and the Calculus Index (CI).

**Table 1: Criteria of Debris Index (DI) of Oral Hygiene Index- Simplified (OHI-S) by (31).**

Scores	Criteria
0	No debris or stain present
1	Soft debris not more than one third of the tooth surface ,or the presence of extrinsic stain without other debris ,regardless of surface area covered.
2	Soft debris covering more than one third but not more than tow third of the exposed tooth surface .
3	Soft debris covering more than tow third of the exposed tooth surface .

**Table 2: Criteria of Calculus Index (CI) of Oral Hygiene Index- Simplified (OHI-S) by (31).**

Scores	Criteria
0	No calculus present
1	Supra gingival calculus covering not more than one third of the exposed tooth surface .
2	Supra gingival calculus covering more than one third but not more than tow third of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.
3	Supra gingival calculus covering more than tow third of the exposed tooth surface, or continuous heavy band of sub gingival calculus around the cervical portion of the tooth ,or both.

**Table 3: Criteria of the Community Periodontal Index of Treatment Needs (CPITN) by (30).**

Code	Criteria
0	No periodontal disease (healthy periodontium)
1	Bleeding observed during or after probing .
2	Calculus or other plaque retentive factors either seen or felt during probing.
3	Pathological pocket in 4-5 mm in depth. Gingival margin situated on black band of the probe.
4	Pathological pocket 6mm or more in depth. Black band of the probe not visible.

**Table 4: Criteria of Treatment Needs of the Community Periodontal Index of Treatment Needs (CPITN) by Jukka *et al.*<sup>[30]</sup>.**

Code	Criteria
0	There is no need for treatment (healthy periodontium)
1	A code of 1 indicate there is need for improving oral hygiene for individual
2 a	A code of 2 indicates need professional cleaning of teeth and removing other retentive factors and oral hygiene improvement.
2b	Oral hygiene improvement with scaling and root planning to reduce pockets of 4-5 mm below 3mm.
3	Deep scaling with root planning and efficient oral hygiene improvement with more complex procedures.

### Statistical Analysis

The spss statistical package for social science version 25 (spss Inc., Chicago, IL, USA) was used for data analysis. Descriptive statistics were performed based on frequency distribution and percentages for categorical data. Crosstabs (contingency tables) are used for frequency and percentage presentation of data. Bar charts are used to graphically represent frequency distributions (counts) and pie chart were used for graphical presentation percentages of data. Comparison between xerostomia scores and variables using chi square test. if chi square was significant, a post hoc comparison was used to detect which cell caused the difference. to detect which cell in the cross tabulation contribute to significant relation, standard residual values (Z score) was considered if  $> \pm 1.96$  (& level) P is significant if  $< 0.05$  as confidence interval 95%.

### Calculation of Indices

#### DMFT Index

Total mean of DMFT index =  $\frac{\text{Sum of total DMFT}}{\text{CPITN (Community of Periodontal Index and Treatment Need)}}$

1-For patient 20 years and above  $\frac{76167}{76167}$

Only 5 teeth on maxilla and 5 teeth for mandible were examined and the worst score recorded .

2-For patient below 19 years  $\frac{616}{616}$

Second molars were excluded due to misdiagnosis with non-inflammatory pocket during eruption. Worst scores were recorded.

**Oral Hygiene Index Simplified (OH-S):** DI and CI were calculated separately then added together to form the total scores of OHI-S.

Debris index =  $\frac{\text{The buccal scores} + \text{The lingual scores}}{\text{Total number examined buccal and lingual surfaces}}$   
 Calculus index =  $\frac{\text{The buccal scores} + \text{The lingual scores}}{\text{Total number examined buccal and lingual surfaces}}$   
 Oral hygiene index= Debris index + Calculus index.

### Dental treatment

Patients were suffering from xerostomia with oral

manifestations like teeth decay, plaque and calculus accumulation due to low salivary flow rate with gingival pockets undergo for scaling and polishing with root planning for gingival pockets removal and oral hygiene measures prescribed like fluoridated tooth paste with mouth wash twice daily and cevimeline or pilocarpine tablets 5mg three times daily used to stimulate saliva secretion to overcome dry mouth<sup>[24]</sup>

## RESULT

Prevalence of xerostomia (dry mouth) among medically compromised persons was (63.4%).

### 1. DMFT

- 63 (100%) of (0-14) DMFT subjects affected by mild xerostomia. 4 (5.6%) (15-19) DMFT patients affected by mild xerostomia. No (0-14) DMFT patients affected by mild xerostomia 96 (52.7%) (20-25) DMFT subjects affected by moderate xerostomia, 68 (94.4%) of 15-19 DMFT subjects affected by moderate xerostomia. no patients had (0-14) DMFT affected by moderate xerostomia
- 86 (47.3%) had (20-25) DMFT subjects affected by severe xerostomia. Neither 15-19 DMFT nor 0-14 subjects affected by severe xerostomia. Total mean od's DMFT (18.62±5.1).
- The frequency distribution (count) of Xerostomia categories within each DMFT category are presented in table and Figure
- The percentage (%) of Xerostomia categories within each DMFT category are presented in table and Figure
- There was a significant relation between DMFT and xerostomia scores (Chi square test,  $p < .001$ )
- Post hoc test indicated that

Subjects with 0-14 DMFT (mean14.53±4.8) were significantly related to mild xerostomia than subjects with other DMFT categories.

Subjects with 20-25 DMFT (mean21.12±8.5) were significantly related to moderate and severe xerostomia than subjects with other DMFT categories.

**Table 5: The Frequency Distribution (%) of Xerostomia Categories Within Each DMFT Category.**

		Xerostomia * DMFT Crosstabulation			Total	
		DMFT				
		0-14 (age 16-35)	15-19 (age36-54)	20-25 (age55-85)		
Xerostomia	Mild	Count	63 <sup>a</sup>	4 <sup>b</sup>	0 <sup>c</sup>	67
		% within DMFT	100.0%	5.6%	0.0%	21.1%
		Adjusted Residual	17.1	-3.7	-10.7	
	Moderate	Count	0 <sup>a</sup>	68 <sup>b</sup>	96 <sup>c</sup>	164
		% within DMFT	0.0%	94.4%	52.7%	51.7%
		Adjusted Residual	-9.2	8.2	.4	
	Sever	Count	0 <sup>a</sup>	0 <sup>a</sup>	86 <sup>b</sup>	86
		% within DMFT	0.0%	0.0%	47.3%	27.1%
		Adjusted Residual	-5.4	-5.9	9.4	
Total	Count	160	63	72	182	
	% within DMFT & Mean	100.0% 14.53±4.8	100.0% 21.65±3.7	100.0% 21.12±8.5	100.0% 18.62±5.1	
	Chi square				276.85	
	P value				<.001*	

Similar subscript letter denotes a subset of AGE categories whose column proportions do not differ significantly from each other at the .05 level. Adjusted residuals (Z-scores)>1.69 indicate significant difference

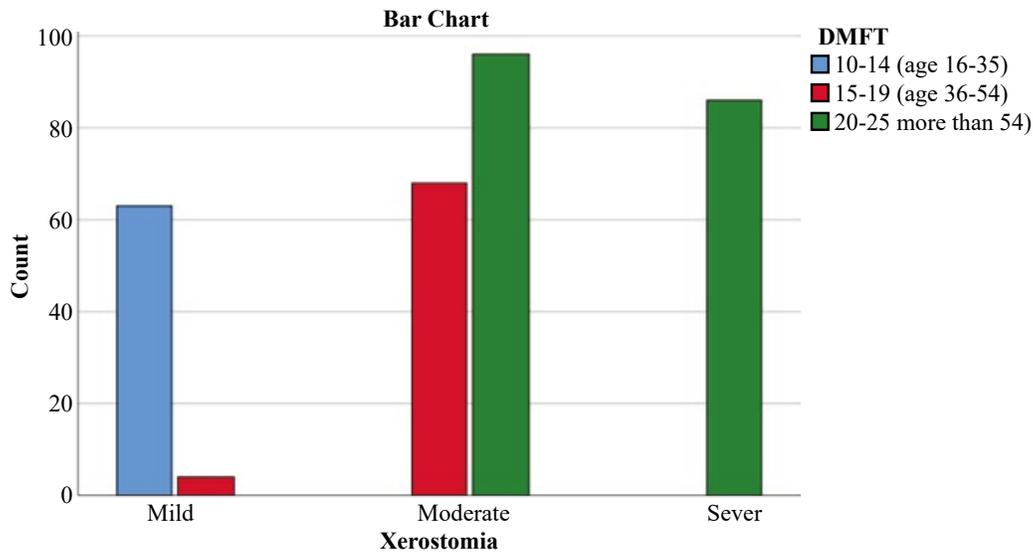


Figure 1: The Frequency Distribution (Count) of Xerostomia Categories Within each DMFT Category.

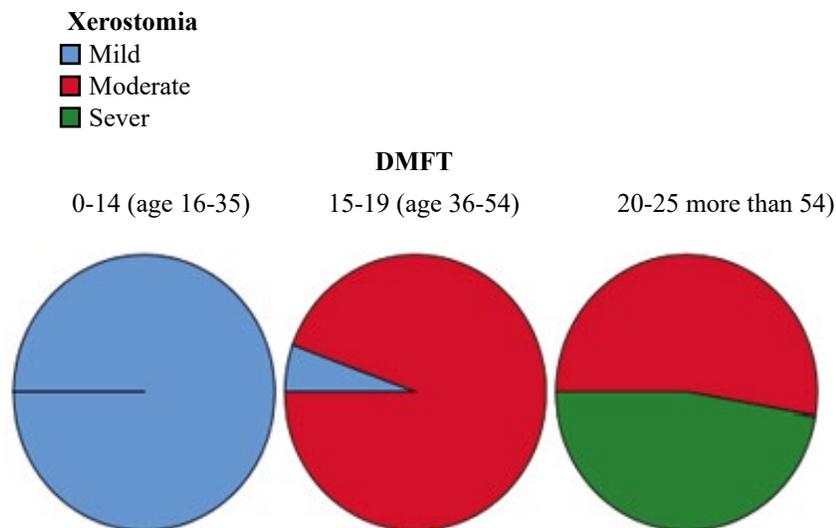


Figure 2: The Percentage (%) of Xerostomia Categories Within each DMFT Category.

**2. CPITN**

- 30 (100%) of subjects with calculus or plaque retention affected by mild xerostomia. 19 (30.2%) of subjects with pocket 4-5mm affected by mild xerostomia. 11 (100%) of subjects with bleeding affected by mild xerostomia. 7 (100%) of subjects with no periodontal disease affected by mild xerostomia. No subjects with pocket 6mm or more affected by mild xerostomia
- 120 (58.3%) of subjects with pocket 6mm or more affected by moderate xerostomia. 44 (69.8%) of subjects with pocket 4-5mm or more affected by moderate xerostomia. No subjects with other categories of CPITN affected by moderate xerostomia
- 86 (41.7%) of subjects with pocket 6mm or more affected by sever xerostomia. No subjects with other categories of CPITN affected by sever xerostomia

- The frequency distribution (count) of Xerostomia categories within each CPITN category are presented in table and Figure
- The percentage (%) of Xerostomia categories within each CPITN category are presented in table and Figure
- There was a significant relation between CPITN and xerostomia scores (Chi square test,  $p < .001$ )
- Post hoc test indicated that

Subjects with calculus or plaque retention were significantly related to mild xerostomia than was expected compared to other CPITN categories. Subjects with pocket depth (4-5mm, 6mm or more) were significantly related to moderate and sever xerostomia respectively than was expected compared to other CPITN categories.

**Table 6: The Frequency Distribution (%) of Xerostomia Categories Within CPITN Category.**

		Xerostomia * CPITN Crosstabulation						
		CPITN						
		No Periodontal Disease	Bleeding after Probing	Calculus or Plaque Retention During Probing	Pathologic Pocket 4-5mm Depth	Pathologic Pocket 6mm or more Depth	Total	
Xerostomia	Mild	Count	7 <sub>a</sub>	11 <sub>a</sub>	30 <sub>a</sub>	19 <sub>b</sub>	0 <sub>c</sub>	67
		% within CPITN	100.0%	100.0%	100.0%	30.2%	0.0%	21.1%
		Adjusted Residual	5.2	6.5	11.1	2.0	-12.6	
	Moderate	Count	0 <sub>a</sub>	0 <sub>a</sub>	0 <sub>a</sub>	44 <sub>b</sub>	120 <sub>b</sub>	164
		% within CPITN	0.0%	0.0%	0.0%	69.8%	58.3%	51.7%
		Adjusted Residual	-2.8	-3.5	-6.0	3.2	3.2	
Sever	Count	0 <sub>a,b</sub>	0 <sub>a,b</sub>	0 <sub>b</sub>	86 <sub>a</sub>	86 <sub>a</sub>	86	
	% within CPITN	0.0%	0.0%	0.0%	0.0%	41.7%	27.1%	
Total	Count	7	11	30	63	206	317	
	% within CPITN	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Chi square		264.07						
P value		<.001*						

Similar subscript letter denotes a subset of CPITN categories whose column proportions do not differ significantly from each other at the .05 level. Adjusted residuals (Z-scores)>1.69 indicate significant difference

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significantly from each other at the .05 level. Adjusted residuals (Z-scores)>1.69 indicate significant difference

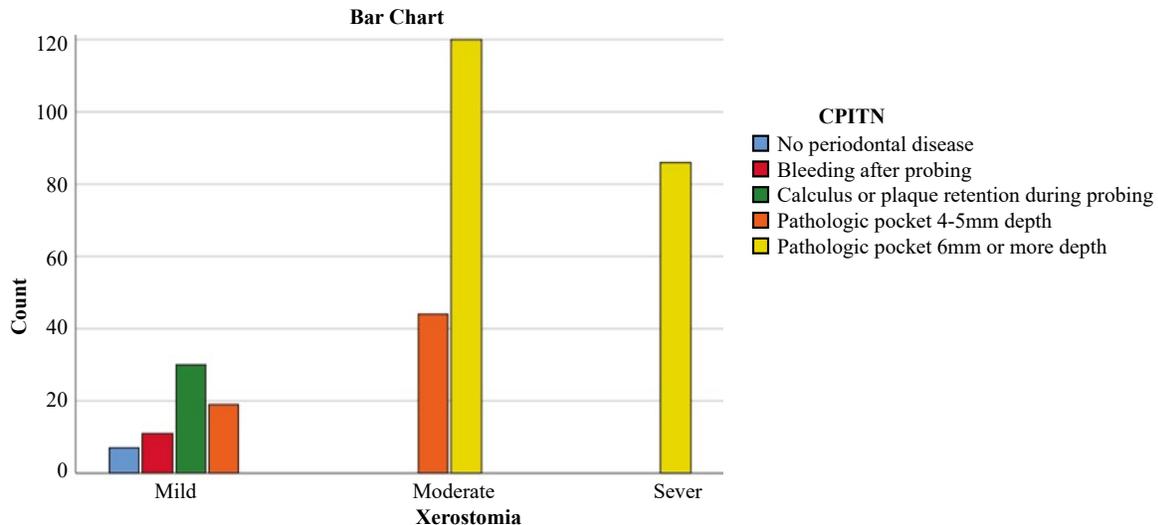


Figure 3: The Frequency Distribution (Count) of Xerostomia Categories Within each CPITN Category.

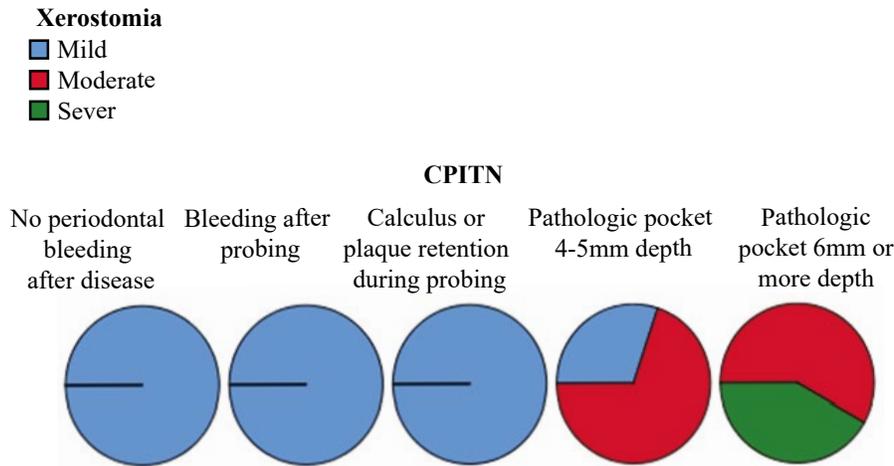


Figure 4: The Percentage (%) of Xerostomia Categories Within each CPITN Category.

**3. Systemic Disease**

- 47 (85.5%) of subjects with arthritis affected by mild xerostomia. 14 (100%) of subjects with strokes affected by mild xerostomia. 6 (100%) of subjects with yeast affected by mild xerostomia. No subjects with other systemic disease category affected by mild xerostomia.
- [8 (14.5%), 19 (100%), 26 (100%), 19 (100%), 9 (100%), 35 (100%) 48 (72.7%)] of subjects were suffering from (arthritis, diarrhea, tumor, Sjogren syndrome, Sialidinitis, liver and renal failure) respectively were significantly related with moderate xerostomia.
- [18 (27.7%) and 68 (100%)] respectively of subjects were significantly related to sever xerostomia.
- The frequency distribution (count) of Xerostomia categories within each oral manifestation category

- are presented in table and Figure
- The percentage (%) of Xerostomia categories within each oral manifestation category are presented in table and Figure
- There was a significant relation between oral manifestation and xerostomia scores (Chi square test,  $p < .001$ )
- Post hoc test indicated that

Arthritis ,yeast and stroke patients were significantly related to mild xerostomia than other systemic diseases categories  
 Liver and renal disease patients were significantly related to moderate xerostomia than other systemic diseases categories  
 Diabetic patients were significantly related to sever xerostomia than other systemic disease categories.

**Table 7: The Frequency Distribution (Account) of Xerostomia Categories with in Each Systemic Diseases Categories.**  
 Xerostomia \* Sys. Disease Crosstabulation

		Sys. Disease										Total	
		Stroke	Yeast	Artheritis	Diarrhea	Tumor	Sjogren Syndrome	Sialidinitis	Liver Diseases	Renal Failure	Diabetes		
Xerostomia	Mild	Count	14 <sub>a</sub>	6 <sub>a</sub>	47 <sub>a</sub>	0 <sub>b</sub>	0 <sub>b</sub>	0 <sub>b</sub>	0 <sub>b</sub>	0 <sub>b</sub>	0 <sub>b</sub>	67	
		% within sys. disease	100.0%	100.0%	85.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	21.1%	
		Adjusted Residual	7.4	4.8	12.9	-2.3	-2.8	-2.3	-1.6	-3.2	-4.7	-4.8	
	Moderate	Count	0 <sub>a</sub>	0 <sub>a</sub>	8 <sub>a</sub>	19 <sub>b,c</sub>	26 <sub>b,c</sub>	19 <sub>b,c</sub>	9 <sub>b,c</sub>	35 <sub>c</sub>	48 <sub>b</sub>	0 <sub>a</sub>	164
		% within sys. disease	0.0%	0.0%	14.5%	100.0%	100.0%	100.0%	100.0%	100.0%	72.7%	0.0%	51.7%
		Adjusted Residual	-4.0	-2.6	-6.1	4.3	5.1	4.3	2.9	6.1	3.8	-9.6	
Sever	Count	0 <sub>a,b</sub>	0 <sub>a,b</sub>	0 <sub>b</sub>	0 <sub>a,b</sub>	0 <sub>a,b</sub>	0 <sub>a,b</sub>	0 <sub>a,b</sub>	0 <sub>b</sub>	18 <sub>a</sub>	68 <sub>c</sub>	86	
	% within sys. disease	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	27.3%	100.0%	27.1%	
	Adjusted Residual	-2.3	-1.5	-5.0	-2.7	-3.2	-2.7	-1.9	-3.8	.0	15.2		
Total	Count	14	6	55	19	26	19	9	35	66	68	317	
	% within sys. disease	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Chi square									219.36				
P value									<.001*				

Similar subscript letter denotes a subset of oral manifestation categories whose column proportions do not differ significantly from each other at the .05 level. Adjusted residuals (Z-scores)>1.69 indicate significant difference

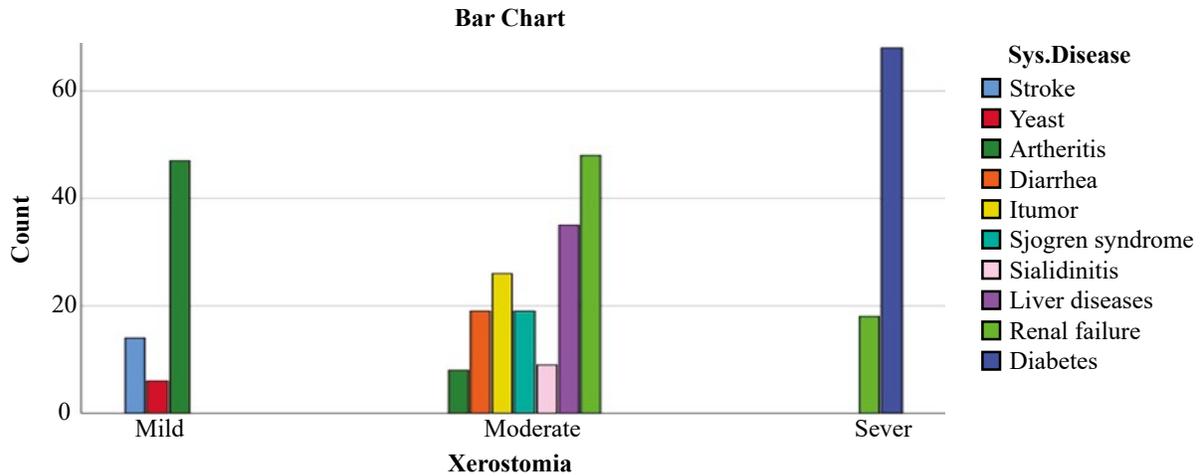


Figure 5: The Frequency Distribution (Count) of Xerostomia Categories Within each Systemic Diseases Category.

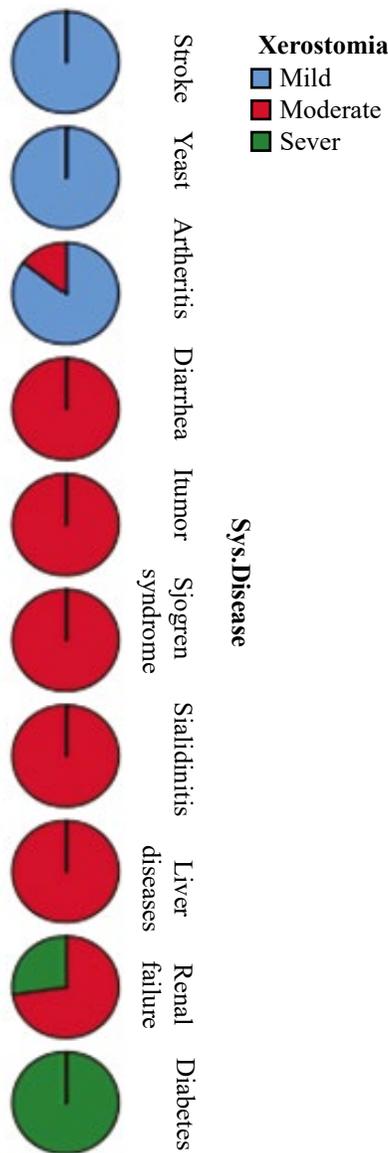


Figure 6: The Percentage (%) of Xerostomia Categories Within each Oral Disease Category.

#### 4. OHI Plaque and Calculus

- [4 (100%), 4 (100%) and 3 (100%)] subjects of score 1, 2 and 3 of plaque index were affected by mild xerostomia. [39 (100%) and 10 (15.9%)] of subjects with score 1 and 2 of calculus index were respectively affected by mild xerostomia.
- 111 (56.3%) of subjects with score 3 of calculus index were affected by moderate xerostomia. 53 (84.1%) of subjects with score 2 of calculus index were affected by moderate xerostomia. No subjects with other categories of OHI plaque index affected by moderate xerostomia.
- 86 (43.7%) of patients with score 3 of calculus index were affected by severe xerostomia. No subjects with other categories of OHI plaque index affected by severe xerostomia.
- The frequency distribution (count) of Xerostomia categories within each OHI plaque and calculus category are presented in table and Figure
- The percentage (%) of Xerostomia categories within each OHI plaque and calculus category are presented in table and Figure
- There was a significant relation between OHI plaque and calculus and xerostomia scores (Chi square test,  $p < .001$ )
- Post hoc test indicated that
- Association of subjects with a score of 1 (supragingival calculus accounting for no more than one-third of the exposed tooth surface) to mild xerostomia compared with subjects with other categories of OHI plaque and calculus significantly higher than expected
- Subjects with score 3 (supragingival calculus covering more than two third of exposed tooth surface with subgingival calculus) were significantly related to moderate, and severe xerostomia than was expected compared to subjects with other categories of OHI plaque and calculus index.

**Table 8: The Frequency Distribution (%) of Xerostomia Categories Within each OHI Plaque and Calculus Category.**

		Ohi Scores PI+Calculus							Total	
		Score0p+c	Score1p	Score2p	Score3p	Score1c	Score2c	Score3c		
Xerostomia	Mild	Count	7 <sup>a</sup>	4 <sup>a</sup>	4 <sup>a</sup>	3 <sup>a</sup>	39 <sup>a</sup>	10 <sup>b</sup>	0 <sup>c</sup>	67
		% within ohi pl+calculus	100.0%	100.0%	100.0%	100.0%	100.0%	15.9%	0.0%	21.1%
		Adjusted Residual	5.2	3.9	3.9	3.4	12.9	-1.1	-11.8	
	Moderate	Count	0 <sup>a,b</sup>	0 <sup>a,b</sup>	0 <sup>a,b</sup>	0 <sup>a,b</sup>	0 <sup>b</sup>	53 <sup>c</sup>	111 <sup>a</sup>	164
		% within ohi pl+calculus	0.0%	0.0%	0.0%	0.0%	0.0%	84.1%	56.3%	51.7%
		Adjusted Residual	-2.8	-2.1	-2.1	-1.8	-6.9	5.7	2.1	
	Sever	Count	0 <sup>a,b</sup>	0 <sup>a,b</sup>	0 <sup>a,b</sup>	0 <sup>a,b</sup>	0 <sup>b</sup>	0 <sup>b</sup>	86 <sup>a</sup>	86
		% within ohi pl+calculus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	43.7%	27.1%
		Adjusted Residual	-1.6	-1.2	-1.2	-1.1	-4.1	-5.4	8.5	
	Total	Count	7	4	4	3	39	63	197	317
		% within ohi pl+calculus	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	Chi square							161.69		
P value							<.001*			

Similar subscript letter denotes a subset of OHI plaque and calculus categories whose column proportions do not differ significantly from each other at the .05 level. Adjusted residuals (Z-scores)>1.69 indicate significant difference

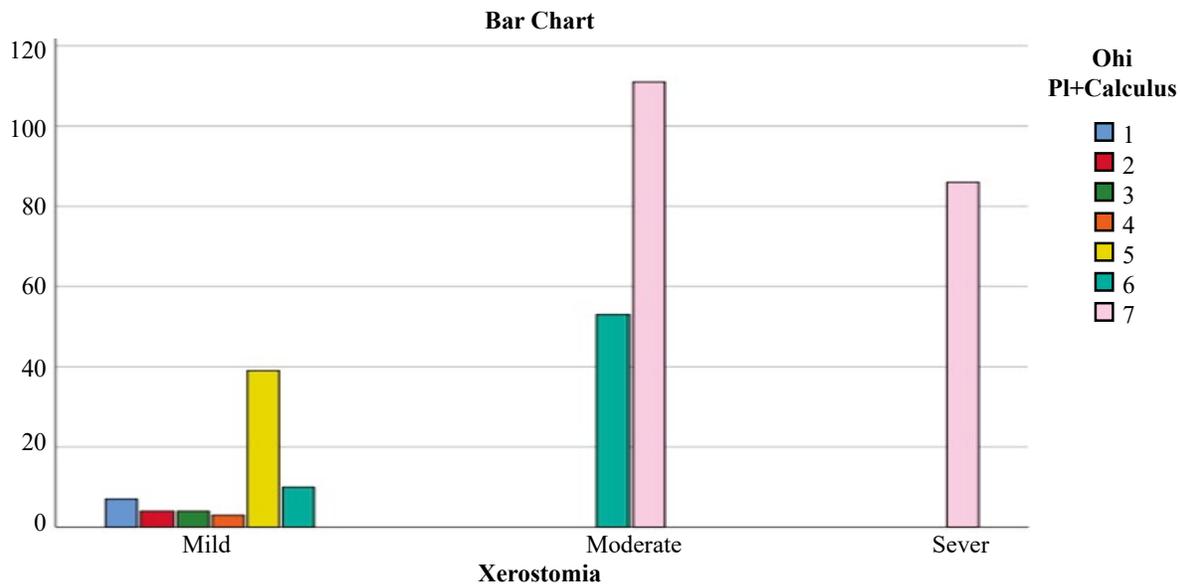


Figure 7: The Frequency Distribution (Count) of Xerostomia Categories Within each OHI Plaque and Calculus Category.

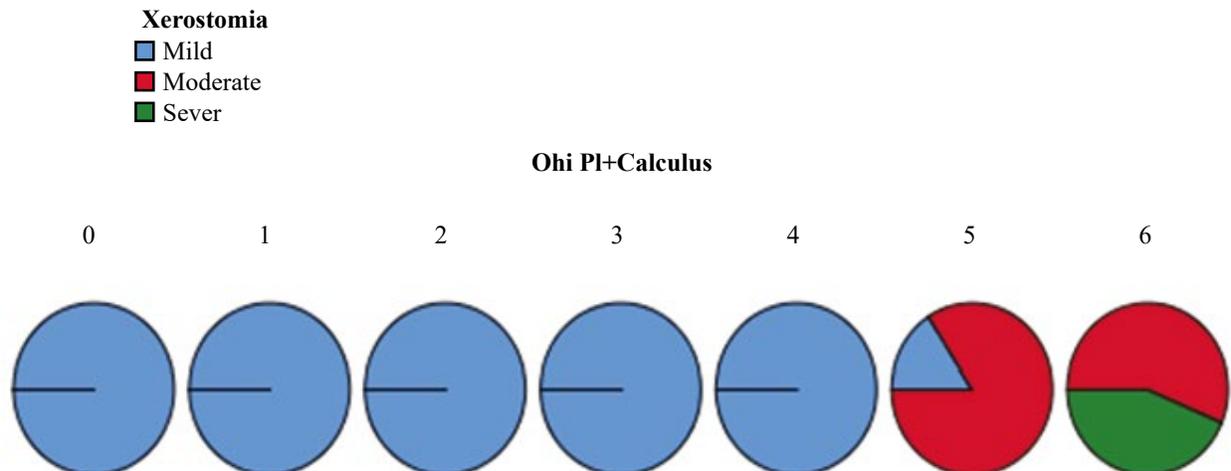


Figure 8: The Percentage (%) of Xerostomia Categories Within each OHI Plaque and Calculus Category.

## DISCUSSION

Xerostomia, also known as hyposalivation, refers to an abnormal decrease in saliva production. Dry mouth can be a symptom of certain disorders or a side effect of some treatments. It can be considered a reflection of systemic disorders.

In Iraq, there was a lack of available studies to assess the frequency of dry mouth in patients with medical conditions and to identify the causes of xerostomia along with its related oral symptoms. The current study aimed to identify the prevalence of xerostomia and its potential etiological factors.<sup>[32]</sup>

Based on the current study, the prevalence of xerostomia was found to be 63.4%. A similar percentage of 64.8% was recorded in Scandinavia. This information was reported by Islas-Granillo *et al.*<sup>[34]</sup>, who found that the percentage of dry mouth among senior patients was 68.3%.<sup>[33,34]</sup>

There is a significant correlation between xerostomia and the DMFT (Decayed, Missing, and Filled) score. The chi-square test conclusively established a statistically significant correlation between the DMFT and the xerostomia scores. The p-value is less than 0.001.

Based on the post hoc analysis, those with DMFT scores ranging from 0 to 14 had a considerably higher likelihood of experiencing mild xerostomia compared to those in other DMFT categories. Conversely, individuals with DMFT scores between 20 and 25 had a significantly higher likelihood of experiencing moderate and severe xerostomia (36). Individuals with xerostomia had significantly elevated DMFT ratings compared to individuals without xerostomia. The study also found a positive link between DMFT score and the degree of xerostomia. After controlling for potential confounding factors such as age, gender, and medication use, a study discovered that individuals with xerostomia exhibited markedly elevated DMFT levels compared to those without this condition.<sup>[33]</sup> A study revealed that those suffering from xerostomia exhibited significantly elevated DMFT levels in comparison to those who did not experience xerostomia. The study also found a high correlation between the severity of xerostomia and the prevalence of damaged and missing teeth.<sup>[33]</sup> Based on these findings, there is a possibility of increased susceptibility to xerostomia in those with subpar oral hygiene, as indicated by a higher DMFT score. The presence of dental decay, missing teeth, and other oral health issues might potentially lead to xerostomia by disrupting the bacterial equilibrium in the mouth or by promoting the accumulation of debris and bacteria in the oral cavity.<sup>[33]</sup> The Community Periodontal Index of Treatment Needs (CPITN) is a standardised instrument used to assess the periodontal (gum) health and treatment needs of a community or population. The CPITN examination is a screening technique that helps assess the extent and seriousness of gum disease in a community as a whole, rather than providing a specific diagnosis. It involves measuring the presence and depth of periodontal pockets around specific teeth, as well as evaluating the overall condition of the periodontal tissues.

<sup>[35]</sup> A strong correlation was found between CPITN and xerostomia scores (Chi square test,  $p < .001$ ). Further analysis revealed that individuals with calculus or plaque retention were more likely to experience mild xerostomia compared to individuals in other CPITN categories. Additionally, individuals with pocket depths of 4-5mm or 6mm or more were more likely to experience moderate and severe xerostomia, respectively, compared to individuals in other CPITN categories.

The scores show varying levels of gum health and corresponding treatment needs. Gum scores of 0 and 1 indicate the presence of generally healthy gums with minimal or no indications of gum disease. Scoring 2 or 3 suggests the presence of gum disease, however its severity may differ. A score of 4 indicates the presence of significant periodontal pockets and advanced gum disease. The CPITN scores are utilised to collect data on the occurrence and treatment needs of periodontal disease in a community. The utilisation of this information facilitates the process of strategizing oral health initiatives, allocating resources, and implementing appropriate treatment programmes to meet the identified needs. It is crucial to recall that a comprehensive periodontal examination conducted by a dental specialist is necessary for a precise diagnosis and identification of a patient's individual treatment needs.<sup>[36]</sup>

There is no causal relationship between CPITN (Community Periodontal Index of Treatment Needs) and xerostomia (dry mouth). Nevertheless, there could potentially exist hypothetical connections or associations between the two: Both periodontal disease (as assessed by CPITN) and xerostomia can be affected by inadequate oral hygiene, accumulation of dental plaque, and calculus formation. Inadequate saliva flow, known as xerostomia, can hamper the self-cleaning and buffering characteristics of saliva, hence increasing the risk of plaque accumulation and gum disease. Xerostomia may arise as a consequence of some medications prescribed for the treatment of specific medical conditions. Moreover, certain medications have the ability to alter the chemical composition of saliva, hence reducing its defensive properties. Drugs that alter the quality or production of saliva in individuals with xerostomia can indirectly affect their periodontal health. This increases the likelihood of developing periodontal disease, as indicated by CPITN. Some systemic disorders, such as the autoimmune disorder Sjögren's syndrome, which is characterised by dry mouth and eyes, can cause both xerostomia (dry mouth) and periodontal (gum) problems. The shared factor in these conditions may be the root cause of both periodontal disease and the symptoms of dry mouth.<sup>[37]</sup>

### Systemic Diseases with Xerostomia

A strong correlation was observed between systemic disorders and xerostomia scores (Chi square test,  $p < .001$ ). Further analysis revealed that patients with arthritis, yeast infections, and stroke had a much higher likelihood of experiencing mild xerostomia compared to individuals with other systemic diseases. Liver and renal disease patients had a higher prevalence of mild xerostomia compared to

those with other systemic disorders. Additionally, diabetic patients had a much higher prevalence of severe xerostomia compared to individuals with other systemic diseases.

Various systemic illnesses result in the involvement of salivary glands, leading to the complication of xerostomia. Salivary hypofunction is commonly associated with diabetes mellitus, end-stage renal disease (ESRD), graft-versus-host disease (GVHD), and autoimmune illnesses. Xerostomia has distinct underlying mechanisms depending on the situation. Xerostomia linked with SLE, RA, PBC, thyroid illness, and some viral infections can be ascribed to autoimmunity. Immunocompetent cells or the formation of granulomas can infiltrate the salivary glands, leading to the impairment of their function in certain disorders such as HIV infection, GVHD, sarcoidosis, and TB. The occurrence of dry mouth in individuals with diabetes and end-stage renal failure is a result of excessive urine production and dehydration. On the other hand, graft-versus-host disease (GVHD) and scleroderma lead to xerostomia by causing fibrosis.<sup>[38]</sup>

Numerous systemic diseases and ailments have been connected to dry mouth, commonly known as xerostomia. Below are multiple instances:

First, Sjögren's Syndrome: Sjögren's syndrome predominantly targets the exocrine glands, with a special emphasis on the salivary glands. The notable features encompass xerostomia, xerophthalmia, and further systemic manifestations. Xerostomia, or dry mouth, is a common symptom of Sjögren's syndrome. Additionally, diabetes is another symptom that might occur. Xerostomia can be caused by uncontrolled hyperglycemia. Dehydration and dry mouth can result from elevated fluid intake and frequent urination caused by high levels of blood sugar. Diabetes can have a detrimental effect on the nerves responsible for controlling salivation, hence exacerbating xerostomia.<sup>[2]</sup> Xerostomia can coexist with autoimmune disorders such as Rheumatoid arthritis, systemic lupus erythematosus (SLE), and systemic sclerosis. These disorders have the potential to immediately impact the salivary glands or disturb the immune system, leading to a decrease in salivation and perhaps resulting in HIV/AIDS. that Xerostomia can occur as a consequence of both the human immunodeficiency virus (HIV) and the acquired immunodeficiency syndrome (AIDS). The virus can directly impact the salivary glands, leading to reduced salivation.<sup>[39]</sup>

### **OHI INDEX PLAQUE and Calculator**

A strong correlation was seen between OHI plaque and calculus and xerostomia scores, as determined by a Chi square test with a p-value of less than .001. The post hoc test revealed that individuals with score 1 (supra gingival calculus not exceeding one third of the exposed tooth surface) were significantly more likely to experience mild xerostomia compared to individuals in other categories of OHI plaque and calculus. On the other hand, individuals with score 3 (supra gingival calculus covering more than two thirds of the exposed tooth surface with subgingival

calculus) were significantly more likely to experience moderate and severe xerostomia compared to individuals in other categories of OHI plaque and calculus index.

There is a substantial correlation between OHI (Oral Hygiene Index) plaque, calculus, and xerostomia. Examining each connection individually in detail The formation of dental plaque, a biofilm consisting of bacteria, food debris, and other substances, occurs due to inadequate oral hygiene practices, leading to its accumulation on the teeth and gums. If plaque is not adequately eliminated through regular brushing and flossing, it can lead to several oral health problems, including dental caries, periodontal disorders, and gingivitis.<sup>[40]</sup>

Xerostomia can exacerbate the condition since it reduces the production of saliva, resulting in less efficient removal of plaque. Plaque formation is reduced due to the antibacterial properties of saliva, which aids in the removal of food particles and detritus. Xerostomia patients experience a decrease in saliva flow, which can lead to a higher buildup of plaque and expedite the progression of dental issues.<sup>[41]</sup>

### **Xerostomia with OHI Calculus (Tartar)**

Dental calculus, often known as tartar, refers to the calcified plaque that accumulates and remains on the teeth for an extended period. Calculus is a tenacious deposit that adheres to the teeth, typically at the gum line. It can induce gum inflammation, gingivitis, and periodontal problems by creating a coarse surface that facilitates more plaque accumulation. Xerostomia reduces the natural cleansing and buffering qualities of saliva, which can lead to the formation of calculus. Saliva plays a crucial role in maintaining a healthy dental environment by neutralising acids and inhibiting the mineralization of plaque. The decreased saliva production in individuals with xerostomia can impede these preventive actions, hence promoting the formation of dental calculus and the attachment of plaque to the teeth.<sup>[42]</sup>

## **CONCLUSION**

The incidence of xerostomia (dry mouth) among individuals with medical conditions was 63.4%. Older females with lower educational levels residing in rural areas had a higher likelihood of experiencing xerostomia. However, there was no significant correlation found between the frequency of dental flossing or the kind of mouthwash used and the occurrence of xerostomia. This study primarily involved participants who were predominantly afflicted with diabetes mellitus, renal and liver disorders, and experienced varying degrees of dry mouth. The analysis revealed a noteworthy distinction between xerostomia and inadequate oral hygiene (as measured by the OHI index), CPITN and DMFT index, as well as candida infection in the fissures of the tongue and lips among those with dry mouth. Utilising precise technical approaches for identification and research of underlying causes is more effective in achieving improved preventive and therapies.

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