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The Interrelationship of Xerostomia and Hyposalivation in Malaysian Older Adults: Sociodemographic and Systemic Factors

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Abstract

Xerostomia and hyposalivation are common yet distinct oral health conditions among older adults with complex medical needs. This cross-sectional study aimed to assess the interrelationship between xerostomia and hyposalivation in terms of prevalence, severity, and associated sociodemographic and systemic factors in older adults attending a University Hospital. Xerostomia was reported by 84% of participants, whereas only 26% demonstrated measurable hyposalivation; notably, 12.5% of participants without perceived dry mouth exhibited objective salivary hypofunction, highlighting a substantial risk of underdiagnosis when relying solely on symptoms. A moderate negative correlation was observed between xerostomia severity and salivary flow ($r = -0.446$, $p = .001$), indicating that greater symptom severity was generally associated with lower salivary output, though the relationship was not absolute. Sociodemographic variables were not significantly associated with xerostomia severity, whereas systemic conditions particularly oncology-related diseases and exposure to xerogenic medications showed meaningful associations. Importantly, the xerogenic potential of specific medications, especially those with anticholinergic properties, emerged as a more important predictor of salivary dysfunction than the total number of medications taken. These findings confirm that xerostomia and hyposalivation are related but not interchangeable conditions and underscore the importance of integrated subjective and objective assessment within a multidisciplinary geriatric care framework.

1. Introduction

Saliva is fundamental to the maintenance of oral and systemic health, serving as a vital exocrine secretion that facilitates lubrication, digestion, and the buffering of oral acids. It plays a crucial role in protecting oral tissues, facilitating mastication, and enhancing gustatory perception, which are all essential for maintaining a high quality of life. However, as the global population undergoes a significant demographic shift, with the proportion of older adults expected to reach 16% by 2050, the prevalence of salivary gland dysfunction is becoming a burgeoning global concern. In the Malaysian context, the nation is rapidly transitioning towards an older population structure; as of 2024, the percentage of Malaysians aged 60 and above stands at 11.6% and is projected to exceed 17.3% by 2040. This demographic transition necessitates a focused examination of oral health challenges in the older adults who present with complex medical and functional needs[1–4].

Clinical evaluations of oral dryness must distinguish between two related but distinct entities: xerostomia and hyposalivation. Xerostomia is defined as the subjective perception or symptom of dry mouth, whereas hyposalivation is the objective clinical sign of a measurable reduction in salivary flow rate. While these conditions frequently overlap, they are not synonymous; individuals may perceive oral dryness despite having normal salivary output, or conversely, exhibit clinically low salivary flow without reporting subjective discomfort. Understanding this interrelationship is paramount for accurate diagnosis, as relying solely on patient-reported symptoms may lead to the underdiagnosis of underlying glandular hypofunction[5–10].

The etiology of salivary dysfunction in older adults is multifactorial, often driven by systemic diseases and the impact of polypharmacy. Conditions such as diabetes mellitus, autoimmune disorders like Sjögren's syndrome, and neurological impairments have been independently associated with both xerostomia and hyposalivation. Furthermore, oncologic treatments, including chemotherapy and head and neck radiotherapy, are well-established causes of irreversible gland fibrosis and severe oral dryness. Compounding these systemic factors is the high medication burden common in geriatric populations. Specifically, medications with high anticholinergic activity, such as antidepressants, antipsychotics, and certain antihypertensives, inhibit the muscarinic receptors essential for saliva production, thereby exerting a xerogenic effect that significantly diminishes salivary output[7,8.22,27]

To date, there is a significant paucity of research focusing specifically on the medically complex older adult population in Southeast Asia and Malaysia. These patients are characterized by multimorbidity and high dependency, yet they often lack the condition-specific evidence required for tailored treatment planning.

Bridging the gap between subjective symptom reporting and objective physiological dysfunction remains a challenge in geriatric dental research. Most existing literature treats xerostomia and hyposalivation as isolated phenomena rather than exploring their interrelationship within a unified clinical framework. There is an urgent need to determine how these conditions coexist and diverge in high-risk groups, such as the older adult population in our setting where systemic disease profiles and pharmacological burdens are uniquely intense.

Therefore, this study aims to assess the interrelationship between xerostomia and hyposalivation from the aspects of prevalence, severity, sociodemographic, and systemic factors in older adults attending the Special Care Dentistry (SCD) Clinic at Universiti Malaya. By evaluating the correlation between subjective perceptions and objective clinical metrics, this research seeks to identify key predictors of salivary dysfunction, ultimately informing more targeted diagnostic and management strategies for this vulnerable geriatric population.

2. Methodology

2.1 Ethical Considerations and Study Registration

The study protocol was conducted in strict adherence to the ethical principles for medical research involving human subjects as outlined in the Declaration of Helsinki. Ethical approval was granted by the Faculty of Dentistry Medical Ethics Committee, Universiti Malaya (Reference Number: **DF CD2501/0011(P)**).

Prior to enrolment, all potential participants were provided with a comprehensive Participant Information Sheet detailing the study's objectives, procedures, potential risks, and benefits. Written informed consent was obtained from all subjects. Given the specific vulnerability of the geriatric population in this setting, special provisions were made for participants with limited literacy or those unable to sign due to physical impairment; in such cases, the consent process was facilitated by a legal guardian or an impartial witness to attest that participation was fully voluntary. Participants were explicitly informed of their right to withdraw from the study at any time without reprisal or impact on their ongoing dental care. To compensate for their time and travel, an honorarium was provided. All personal data were pseudonymized and stored in password-protected databases, accessible only to the primary investigators to guarantee patient confidentiality and anonymity throughout the research process.

2.2 Study Design and Clinical Setting

A cross-sectional observational study design was employed to evaluate the interrelationship between subjective xerostomia and objective hyposalivation. The research was conducted at the Special Care Dentistry (SCD) Clinic within the Faculty of Dentistry, Universiti Malaya, between January 2025 and May 2025. This setting was deliberately selected to capture a specific, high-risk geriatric cohort often underrepresented in general oral health research. Unlike general dental practice populations, patients attending the SCD clinic are characterized by frailty, complex multimorbidity, physical dependency, and cognitive impairments, necessitating specialized clinical management.

2.3 Participant Selection and Sampling Strategy

The study population comprised older adults attending the SCD clinic for routine dental maintenance or treatment. The inclusion criteria were defined as individuals aged 60 years or older who were registered patients of the clinic during the study period. Exclusion criteria were strictly applied to individuals lacking the cognitive capacity to provide valid informed consent or those unable to comprehend the study procedures, ensuring ethical compliance regarding vulnerable subjects.

To minimize selection bias and ensure a representative sample of this unique clinical population, a systematic random sampling technique was utilized. Based on the clinic's average quarterly attendance, the target sample size was calculated using the Krejcie and Morgan formula to achieve a 95% confidence level with a 5% margin of error. The recruitment process involved selecting every alternate eligible older adult (i.e., every second patient) from the daily appointment registry until the target sample size of 50 participants was achieved.

2.4 Data Collection: Sociodemographic and Systemic Factors

Data collection was performed using a standardized, structured questionnaire digitized via Google Forms. To accommodate potential limitations in manual dexterity, vision, or literacy among the elderly participants, the questionnaire was researcher-administered.

2.4.1 Sociodemographic Variables

Data were gathered regarding age, gender, marital status, and education level (dichotomized into basic and advanced). Residential status was recorded to distinguish between community-dwelling individuals and those residing in institutional care facilities. Functional status was evaluated using Activities of Daily Living (ADL) scores, categorizing patients as independent, partially dependent, or dependent. Lifestyle risk factors, specifically smoking habits (daily smoker, former smoker, or never smoker) and alcohol consumption (current, former, or lifetime abstainer), were also documented.

2.4.2 Systemic Disease and Medication Review

A comprehensive review of electronic medical records was conducted to verify self-reported health data. Systemic conditions were categorized into major domains, including cardiovascular, endocrine (specifically Diabetes Mellitus), oncology, renal, neurological, and psychiatric conditions.

2.4.3 Pharmacological Classification

A critical component of this study was the detailed analysis of medication regimens. Polypharmacy was operationally defined as the concurrent daily use of five or more medications. Beyond simple enumeration, medications were classified according to their potential impact on salivary function, following the pharmacodynamic classification system proposed by Fernandes et al. Drugs were stratified into four distinct categories:

1. **Xerogenic Drugs**: Agents with established anticholinergic or sympathomimetic mechanisms known to inhibit salivary secretion (e.g., tricyclic antidepressants like amitriptyline, antipsychotics such as quetiapine, and benzodiazepines like lorazepam).
2. **Variable Interference**: Medications with dose-dependent, idiosyncratic, or inconsistent effects on saliva (e.g., antihypertensives including amlodipine, diuretics, and proton-pump inhibitors).
3. **No Evidence of Interference**: Pharmacological agents with no known adverse effects on salivary glands (e.g., vitamins, calcium carbonate, and mineral supplements).
4. **Antixerogenic**: Cholinergic agonists used to stimulate saliva (none were present in the current sample).

2.5 Assessment of Xerostomia (Subjective Symptoms)

Subjective perception of dry mouth was assessed using the Shortened Summated Xerostomia Inventory-Dutch Version (SXI-D). This valid and reliable instrument was chosen for its brevity and suitability for geriatric populations. It consists of five items reflecting the severity of symptoms over the preceding four weeks: (1) "My mouth feels dry when eating a meal," (2) "My mouth feels dry," (3) "Difficulty eating dry foods," (4) "Difficulties swallowing certain foods," and (5) "My lips feel dry."

Participants responded to each item using a 3-point Likert scale: "Never" (scored as 1), "Occasionally" (scored as 2), and "Often" (scored as 3). Item scores were summed to produce a total SXI-D score ranging from 5 to 15. The severity of xerostomia was stratified based on these cumulative scores: a score of 5 indicated No Dry Mouth; 6–8 indicated Mild Xerostomia; 9–12 indicated Moderate Xerostomia; and 13–15 indicated Severe Xerostomia.

2.6 Sialometry: Unstimulated Whole Saliva Collection

Objective salivary function was quantified using the Unstimulated Whole Saliva (UWS) collection method. UWS was selected over stimulated sialometry as it is less invasive, poses a lower risk of aspiration for frail elderly patients with dysphagia, and provides a more accurate representation of basal glandular function and the resting oral environment.

To minimize the confounding effects of circadian rhythms on salivary flow, all sialometrry assessments were standardized to occur in the morning, between 9:00 AM and 11:00 AM. Strict pre-collection protocols were enforced: participants were instructed to fast and refrain from drinking, smoking, chewing gum, or performing oral hygiene procedures for at least one hour prior to the appointment.

During the collection, participants were seated in a relaxed, upright position with their head tilted slightly forward to facilitate passive flow. The "passive spitting" or "drooling" method was employed. Participants were first asked to swallow any residual saliva to clear the oral cavity. Subsequently, they were instructed to allow saliva to pool in the floor of the mouth without mechanical stimulation (such as chewing or tongue movements) and to expectorate the accumulated fluid into a pre-weighed, graduated collection tube every 60 seconds. This process was continued for a total duration of 5 minutes. Samples containing visible blood or excessive foam were discarded and the procedure repeated after a settling period to ensure volumetric accuracy.

The volume of collected saliva was measured immediately, and the flow rate was calculated in milliliters per minute (mL/min). Hyposalivation was diagnostically defined as a flow rate of **<** 0.1 mL/min. A flow rate of 0.1 mL/min was classified as normal salivary function, in accordance with internationally accepted standards for geriatric oral health.

2.7 Statistical Analysis

Data management and analysis were performed using IBM SPSS Statistics, version 29.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to characterize the study population. The normality of continuous variables, specifically SXI-D scores and salivary flow rates, was verified using skewness and kurtosis z-scores (acceptance range).

Bivariate analyses employed Chi-square tests to evaluate associations between categorical variables, such as the relationship between xerostomia severity groups and hyposalivation status, as well as associations with sociodemographic factors. Pearson’s correlation coefficient was utilized to determine the strength and direction of the linear relationship between the continuous variables of subjective symptom scores and objective flow rates.

To adjust for potential confounders and identify predictors of dysfunction, regression modeling was applied. Ordinal Logistic Regression assessed the impact of medication categories on the severity of xerostomia, while Binary Logistic Regression estimated the Odds Ratios (OR) for the presence of hyposalivation based on medication classifications. A p-value of was considered statistically significant for all tests.

3. Results

Participant Characteristics A total of 50 older adults attending the Special Care Dentistry (SCD) Clinic at Universiti Malaya were recruited for this study. The sociodemographic and clinical profiles of the study population are summarised in Table 1. The participants ranged in age from 60 to 89 years, with the majority (88%; n=44) falling within the 60–79 age bracket. The gender distribution showed a predominance of females (68%; n=34) compared to males (32%; n=16). Regarding marital status, nearly all participants were married (94%; n=47), with a small minority being single (4%) or widowed (2%).

A defining characteristic of this "Special Care" cohort was the high prevalence of functional dependency. Assessment of Activities of Daily Living (ADL) revealed that only 8% (n=4) of the participants were fully independent. The vast majority were classified as ADL dependent (76%; n=38), while 16% (n=8) were partially dependent. despite this high level of functional reliance, 88% (n=44) of the participants were community-dwelling, residing in non-institutional settings, while only 12% (n=6) resided in institutional care facilities.

Lifestyle risk factors were generally low in this sample. The majority were never-smokers (76%; n=38), with only 4% (n=2) identifying as current daily smokers. Similarly, 52% (n=26) were lifetime alcohol abstainers. Regarding pharmacological management, polypharmacy, defined as the concurrent use of five or more medications was present in 30% (n=15) of the population, whereas 70% (n=35) were managed on fewer than five daily medications.

Table 1: Sociodemographic and Systemic Factors of the Older Adults with Special Needs attending Special Care Dentistry, Universiti Malaya

	Male (n = 16)	Female (n = 34)
Age (Years)		
60-69	6 (37.5%)	14 (41.2%)
70-79	9 (56.2%)	15 (44.1%)
80-89	1 (6.3%)	5 (14.7%)
Education Level		
Basic Education	7 (43.8%)	20 (58.8%)
Advanced Education	9 (56.2%)	14 (41.2%)
Marital Status		
Single	2 (12.5%)	0 (0%)
Married	14 (87.5%)	33 (97.1%)
Widowed	0 (0%)	1 (2.9%)
Activities of Daily Life (ADL) Dependency		
ADL Independent	9 (56.2%)	29 (85.3%)
ADL Partially Dependent	4 (25.0)	0 (0%)
ADL Dependent	3 (18.8%)	5 (14.7%)
Residential Status		
Institutionalized	3 (18.8%)	3 (8.8%)
Non-Institutionalized	13 (81.2%)	31 (91.2%)
Smoking		
Daily Smoker	0 (0%)	2 (5.9%)
Former Smoker	7 (43.8%)	3 (8.8%)
Never Smoker	9 (56.2%)	29 (85.3%)
Alcohol Intake		
Lifetime Abstainer	5 (31.2%)	21 ((61.8%)
Former Drinker	7 (43.8%)	6 (17.6%)
Current Drinker	4 (25.0%(	7 (20.6%)
Number of Medications taken:		
<5 medications	11 (68.8%)	24 (70.6%)
≥ 5 Medications	5 (31.2%)	10 (29.4%)

Prevalence of Xerostomia and Hyposalivation

The distribution of subjective xerostomia and objective hyposalivation is presented in Table 2. Subjective oral dryness was a highly prevalent complaint, with 84% (n=42) of the study population reporting some degree of xerostomia (Summated Xerostomia Inventory-Dutch [SXI-D] score ≥ 6). Conversely, only 16% (n=8) reported no dry mouth symptoms.

Objective assessment via unstimulated whole saliva (UWS) collection identified hyposalivation (flow rate < 0.1 mL/min) in 26% (n=13) of the total sample. When analyzing the co-occurrence of these conditions, the data revealed a discordance between symptoms and signs. Among the 42 participants reporting xerostomia, only 28.6% (n=12) exhibited measurable hyposalivation. This indicates that a significant proportion of patients perceiving dry mouth maintained salivary flow rates above the diagnostic threshold for hyposalivation.

Crucially, the data highlighted a risk asymptomatic hyposalivation. Among the group who reported no subjective symptoms of dry mouth (n=8), 12.5% (n=1) were found to be hyposalivators upon clinical measurement. This finding underscores the potential for underdiagnosis when clinical assessment relies solely on patient-reported outcomes without sialometric verification.

Table 2: Distribution of Xerostomia and Hyposalivation Among Older Adults

(N = 50)

Xerostomia	Total (N = 50)	Percentage of Xerostomia (%)	With Hyposalivation	Percentage with Hyposalivation
No Xerostomia	8	16%	1	12.5%
Xerostomia Present	42	84%	12	28.6%
Total	50	100%	13	26.0%

[1]Note: The value "26.0%" represents the overall proportion of participants with hyposalivation (13 out of 50 participants). Percentages in the column do not add up to 100% because they represent subgroup-specific proportions, not parts of a whole.

Correlation between Subjective and Objective Findings

A detailed crosstabulation of xerostomia severity against hyposalivation status (Table 3) demonstrated a clear progressive trend. The prevalence of hyposalivation rose sharply with increasing symptom severity. Specifically, hyposalivation was detected in 12.5% of asymptomatic patients, 17.4% of those with mild xerostomia, and 20.0% of those with moderate xerostomia. In the group reporting severe xerostomia, the prevalence of hyposalivation spiked to 66.7%.

Statistical analysis confirmed a significant association between xerostomia severity and the presence of hyposalivation (Pearson χ^2 =9.567, df=3, p=0.023). Furthermore, a linear-by-linear association test indicated a significant trend (p=0.009), confirming that higher subjective distress scores were reliably predictive of objective salivary hypofunction in this population.

To quantify the strength of this relationship, a Pearson correlation analysis was conducted on the continuous variables (SXI-D scores and UWS flow rates). The analysis revealed a moderate, statistically significant negative correlation (r=−0.446, p=0.001). This negative coefficient indicates that as the subjective score for dry mouth increases (worsens), the objective volume of saliva produced per minute significantly decreases.

Table 3: Relationship Between Xerostomia Severity and Hyposalivation Among Older Adults Attending Special Care Dentistry (SCD) Clinic (N = 50)

Xerostomia Status	Xerostomia Severity	Normal Saliva (n)	Hyposalivation (n)	Total (N)	Prevalence of Hyposalivation (%)
No Xerostomia	No Dry Mouth	7	1	8	12.5%
Xerostomia Present	Mild Dry Mouth	19	4	23	17.4%
	Moderate Dry Mouth	8	2	10	20.0%
	Severe Dry Mouth	3	6	9	66.7%
	Total	37	13	50	**26.0%**

Table 4: Pearson Correlation Between Severity of Xerostomia and Level of Hyposalivation

		Severity of Xerostomia	Level of Hyposalivation
Severity Of Xerostomia	Pearson Correlation	1	*-0.446*
	Sig (2-tail)	-	0.001
	N	50	50
Level of Hyposalivation	Pearson Correlation	*-0.446*	1
	Sig (2-tail)	0.001	-
	N	50	50

Sociodemographic Associations

Bivariate analyses were conducted to determine if sociodemographic variables were predictors of either xerostomia severity or hyposalivation. As detailed in Supplementary Table S1, no statistically significant associations were found between sociodemographic characteristics and the severity of xerostomia. Gender (p=0.983), age (p=0.769), education level (p=0.352), marital status (p=0.438), and residential status (p=0.995) all failed to show significant correlations with dry mouth symptoms. Similarly, functional dependency (ADL status) was not a significant predictor (p=0.690).

When examining objective hyposalivation as the dependent variable, a similar pattern of non-significance was observed for sociodemographic factors. There were no significant differences in salivary flow rates based on gender (p=0.562), age grouping (p=0.351), or education (p=0.526). This suggests that in this specific medically compromised cohort, biological and systemic factors likely outweigh demographic characteristics as drivers of salivary dysfunction.

Table 5: Distribution of Sociodemographic and Clinical Characteristics by Xerostomia Severity Among Older Adults Attending (SCD) Clinic, Universiti Malaya

	Severity of Xerostomia				
	No Dry Mouth	**Mild Dry Mouth**	**Moderate Dry Mouth**	**Severe Dry Mouth**	***P-value***
	(n = 8)	**(n = 23)**	**(n = 10)**	**(n = 9)**	
Marital Status					
Single	0 (0%)	1 (50%)	1 (50%)	0 (0%)	*0.438*
Married	8 (17.0%)	22 (46.8%)	8 (17.0%)	9 (19.1%)	
Widowed	0 (0%)	0 (0%)	1 (100.0%)	0 (0%)	
Activities of Daily Life (ADL) Dependency					
ADL Independent					
ADL Partially Dependent	6 (15.8%)	17 (44.7%)	9 (23.7%)	6 (15.8%)	*0.690*
ADL Dependent	2 (22.2%)	5 (55.6%)	0 (0%)	2 (22.2%)	
	0 (0%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	
Residential Status					
Institutionalized	1 (16.7%)	3 (50.0%)	1 (16.7%)	1 (16.7%)	*0.995*
Non-Institutionalized	7 (15.9%)	20 (45.5%)	9 (20.5%)	8 (18.2%)	
Smoking					
Daily Smoker	0 (0%)	1 (50.0%)	1 (50.0%)	0 (0%)	*0.725*
Former Smoker	3 (30.0%)	4 (40.0%)	1 (10.0%)	2 (20.0%)	
Never Smoker	5 (13.2%)	18 (47.4%)	8 (21.1%)	7 (18.4%)	
Alcohol Intake					
Lifetime Abstainer	3 (11.5%)	11 (42.3%)	7 (26.9%)	5 (19.2%)	*0.583*
Former Drinker	3 (23.1%)	5 (38.5%)	3 (23.1%)	2 (15.4%)	
Current Drinker	2 (18.2%)	7 (63.6%)	0 (0%)	2 (18.2%)	
Number of Medications taken:					
< 5 Medications					
≥ 5 Medications	5 (14.3%)	16 (45.7%)	6 (17.1%)	8 (22.9%)	*0.583*
	3 (20.0%)	7 (46.7%)	4 (26.7%)	1 (6.7%)	

Table 6: Distribution of Sociodemographic and Clinical Characteristics by Level of Salivation Among Older Adults Attending Special Care Dentistry (SCD) Clinic, Universiti Malaya

	Normal (n =37)	Hyposalivation (n = 13)	*P-value*
Gender:			
Male	11 (68.8%)	5 (31.3%)	*0.562*
Female	26 (76.5%)	8 (23.5%)	
Age (Years)			
60-69	17 (85%)	3 (15.0%)	*0.351*
70-79	16 (66.7%)	8 (33.3%)	
80-89	4 (66.7%)	2 (33.3%)	
Education Level			
Basic Education			
Advanced Education	19 (70.4%)	8 (29.6%)	*0.526*
	18 (78.3%)	5 (21.7%)	
Marital Status			
Single	2 (100.0%)	0 (0%)	*0.169*
Married	35 (74.5%)	12 (25.5%)	
Widowed	0 (0%)	1 (100.0%)	
Activities of Daily Life (ADL) Dependency			
ADL Independent			
ADL Partially Dependent			
ADL Dependent			
	29 (76.3%)	9 (23.7%)	*0.802*
	6 (66.7%)	3 (33.3%)	
	2 (66.7%)	1 (33.3%)	
Residential Status			
Institutionalized			*0.578*
Non-Institutionalized	5 (83.3%)	1 (16.7%)	
	32 (72.7%)	12 (27.3%)	
Smoking			
Daily Smoker	2 (100%)	0 (0%)	*0.674*
Former Smoker	7 (70.0%)	3 (30.0%)	
Never Smoker	28 (73.7%)	10 (26.3%)	
Alcohol Intake			
Lifetime abstainer	17 (65.4%)	9 (24.6%)	*0.348*
Former Drinker	11 (84.6%)	2 (15.4%)	
Number of Medications taken:			
≥ 5 Medications			
< 5 Medications			

	14 (93.3%)	1 (6.7%)	*0.041*
	23 (65.7%)	12 (34.3%)	

Systemic Factors and Medication Effects

The relationship between systemic disease categories and salivary outcomes yielded specific trends. While most systemic conditions (cardiovascular, endocrine, neurological) did not show statistically significant associations with xerostomia severity ($p>0.05$), a notable borderline trend was observed for oncology-related conditions ($p=0.053$). Participants with a history of cancer were disproportionately represented in the "severe xerostomia" category (33.3%), likely reflecting the long-term xerogenic sequelae of oncologic interventions such as chemotherapy or head and neck radiotherapy.

Regarding medication usage, a statistically significant association was identified between the quantity of medications and objective hyposalivation (χ^2, $p=0.041$). Contrary to the typical "polypharmacy" hypothesis where increased drug counts correlate with decreased flow, this study observed an inverse relationship. Hyposalivation was significantly more prevalent among participants taking fewer than five medications (34.3%; n=12/35) compared to those with established polypharmacy taking five or more medications (6.7%; n=1/15). This unexpected finding prompted a deeper investigation into the types of medications used rather than the mere count.

Medications were classified into four pharmacodynamic categories: Xerogenic (anticholinergics, antipsychotics), Variable Interference (antihypertensives, diuretics), No Evidence of Interference (vitamins), and Antixerogenic (sialogogues). In this sample, 26% of participants were taking confirmed xerogenic drugs, while 72% were on medications with variable interference.

Table 7: Distribution of Xerostomia Severity Across Systemic Disease Categories in Older Adults Attending the Special Care Dentistry (SCD) Clinic, Universiti of Malaya

Systemic Disease	N (Total and percentage)	No Dry Mouth	Mild Dry Mouth	Moderate Dry Mouth	Severe Dry Mouth	P-Value
Cardiovascular Disease	22 (44.0%)	2 (9.1%)	13 (59.1%)	4 (18.2%)	3 (13.6%)	*0.374*
Endocrine	21 (42.0%)	4 (11%)	11 (52.4%)	4 (19.0%)	2 (9.5%)	*0.574*
Oncology	21 (42.0%)	1 (4.8%)	9 (42.9%)	4 (19.0%)	7 (33.3%)	*0.053*
Renal	3 (6.0%)	1 (33.3%)	1 (33.3%)	0 (33.3%)	1 (33.3%)	*0.622*
Neurological	8 (16.0%)	2 (25.0%)	4 (50.0%)	2 (25.0%)	0 (0%)	*0.503*
Musculoskeletal	17 (34.0%)	4 (23.5%)	7 (41.2%)	3 (17.6%)	3 (17.6%)	*0.773*
Respiratory	3 (6.0%)	0 (0%)	1 (33.3%)	2 (66.7%)	0 (0%)	*0.197*
Psychiatric	2 (4.0%)	0 (0%)	2 (100.0%)	0 (0%)	0 (0%)	*0.485*
Urology	3 (6.0%)	0 (0%)	2 (66.7%)	1 (33.3%)	0 (0%)	*0.645*

Table 8: Distribution of Hyposalivation Across Systemic Disease Categories Based on Ratio Comparison Method

Systemic Disease	N (Total and Percentage)	Normal	Hyposalivation	P-Value
Cardiovascular	22 (44.0%)	18 (81.8%)	4 (18%)	*0.003*
Endocrine	21 (42.0%)	16 (76.2%)	5 (23.8%)	*0.002*
Oncology	21 (42.0%)	13 (61.9%)	8 (38.1%)	*0.016*
Renal	3 (6.0%)	1 (33.3%)	2 (66.7%)	*0.655**
Neurological	8 (16.0%)	7 (87.5%)	1 (12.5%)	*0.020*
Musculoskeletal	37 (74.0%)	17 (34.0%)	13 (26.0%)	*0.001*
Respiratory	3 (6%)	3 (100.0%)	0 (0%)	*NA*
Psychiatric	2 (4.0%)	2 (100.0%)	0 (0%)	*NA*
Urology	3 (6.0%)	3 (100.0%)	0 (0%)	*NA*

Regression Analysis

To further elucidate the predictors of salivary dysfunction, regression models were applied. An Ordinal Logistic Regression was performed to estimate medication categories as predictors of xerostomia severity. The model indicated that the use of xerogenic drugs was associated with a slight, non-significant increase in xerostomia severity (β=0.083, p=0.793). Medications with variable interference showed a stronger positive regression coefficient (β=0.357, p=0.246), suggesting a potential trend toward worsening symptoms, though this did not reach statistical significance. The confidence intervals for all predictors crossed zero, suggesting imprecision likely due to sample size limitations.

Subsequently, a Binary Logistic Regression was employed to determine the likelihood (Odds Ratio) of hyposalivation based on medication categories. The analysis did not identify any medication category as a statistically significant independent predictor (p>0.05). The regression coefficient for xerogenic drugs was positive (β=0.143, p=0.320), indicating a slight increase in the likelihood of hyposalivation, but the effect was weak. Interestingly, drugs with "Variable Interference" showed a negative coefficient (β=−0.063, p=0.654), while those with "No Evidence of Interference" showed a non-significant positive coefficient (β=0.175, p=0.178).

These regression results, combined with the significant Chi-square finding for medication quantity (p=0.041), suggest that while the broad categorization of drugs did not yield linear predictors, the specific pharmacological burden in patients on limited but potent regimens (e.g., those taking 1-2 potent anticholinergics) may drive hyposalivation more than diffuse polypharmacy in this specific population.

Table 9: Distribution of Xerostomia Severity Across Different Drug Categories Among Older Adults Attending the Special Care Dentistry (SCD) Clinic, Universiti Malaya

Drug Category	Total (N)	No Dry Mouth (n,%)	Mild Dry Mouth (n,%)	Moderate Dry Mouth (n,%)	Severe Dry Mouth (n,%)	P value
Xerogenic Drugs = 0	37	7 (18.9%)	16 (43.2%)	7 (18.9%)	7 (18.9%)	0.767
Xerogenic Drugs = 1	13	1 (7.7%)	7 (53.8%)	3 (23.1%)	2 (15.4%)	
Variable Interference = 0	14	3 (21.4%)	7 (50.0%)	3 (21.4%)	1 (7.1%)	0.633
Variable Interference = 1	36	5 (13.9%)	16 (44.4%)	7 (19.4%)	8 (22.2%)	
No Evidence of Interference = 0	19	2 (10.5%)	12 (63.2%)	1 (5.3%)	4 (21.1%)	0.111
No Evidence of Interference = 1	31	6 (19.4%)	11 (35.5%)	9 (29.0%)	5 (16.1%)	
Antixerogenic Drugs = 0	50	8 (16.0%)	23 (46.0%)	10 (20.0%)	9 (18.0%)	NA

Table 10: Ordinal Logistic Regression Estimates of the Association Between Medication Categories and Xerostomia Severity

Predictor	Estimate (β)	Std. Error	t	df	p-value	95% CI (Lower–Upper)
Xerogenic Drugs (0 vs 1)	0.083	0.315	0.264	1	0.793	(-0.551, 0.717)
Variable Interference (0 vs 1)	0.357	0.304	1.175	1	0.246	(-0.254, 0.968)
No Evidence of Interference (0 vs 1)	0.051	0.285	0.179	1	0.859	(-0.522, 0.624)

Table 11: Association Between Medication Categories and Hyposalivation Using Chi-Square Analysis

Drug Category	Hyposalivation in Group 0 (%)	Hyposalivation in Group 1 (%)	Pearson Chi-Square	df	p-value
Xerogenic Drugs	29.7%	15.4%	1.029	1	0.31
Antixerogenic Drugs	26.0%	-	-	-	-
Variable Interference	21.4%	27.8%	0.211	1	0.646
No Evidence of Interference	36.8%	19.4%	1.872	1	0.171

Table 12: Binary Logistic Regression Analysis of Drug Categories as Predictors of Hyposalivation

Predictor	Estimate (β)	Std. Error	t	df	p-value	95% CI
Xerogenic Drugs = 1	0.143	0.143	0.143	1	0.320	(-0.144, 0.431)
Variable Interference = 1	-0.063	0.141	-0.451	1	0.654	(-0.346, 0.219
No Evidence Interference = 1	0.175	0.128	1.367	1	0.178	-0.082, 0.432)

4. Discussion

The present study investigated the interrelationship between xerostomia and hyposalivation in a cohort of older adults attending a Special Care Dentistry (SCD) clinic, a population characterised by high functional dependency and multimorbidity. The findings reveal a marked discordance between subjective symptoms and objective clinical signs. While xerostomia was highly prevalent, reported by 84% (n = 42) of participants, measurable hyposalivation (unstimulated whole saliva < 0.1 mL/min) was confirmed in only 26% (n = 13) of the total cohort. This discrepancy aligns with the broader geriatric literature, confirming that the sensation of dry mouth and the physiological reduction of salivary flow are distinct, albeit overlapping, clinical entities.

Of clinical significance is the identification of "asymptomatic hyposalivation." In this study, 12.5% of participants who reported no subjective symptoms of dry mouth were found to have objective hyposalivation upon sialometry assessment. This finding identifies a critical "blind spot" in geriatric care: reliance solely on patient-reported outcomes (such as the Xerostomia Inventory) may lead to the underdiagnosis of glandular hypofunction in a minority of patients. In a Special Care setting, where patients may have altered sensory perception or cognitive barriers to reporting symptoms, this "silent" hyposalivation poses a risk for unchecked dental caries and mucosal infections. Consequently, this study reinforces the necessity of integrating objective sialometry into routine screening protocols for vulnerable older adults, regardless of their subjective complaints.

4.1 The Subjective-Objective Gap

Statistical analysis in this study demonstrated a moderate, significant negative correlation ($r = -0.446$, $p = 0.001$) between xerostomia severity and salivary flow rates. This indicates that while the two conditions are not synonymous, severe subjective distress is a reasonably reliable predictor of physiological hypofunction in this specific population. This correlation is stronger than that reported in some community-based studies, such as those by Ohara et al. (2016) and Morita et al. (2023), which found weaker or non-existent associations in healthier elderly cohorts[6,9].

The persistence of the subjective-objective gap, where 71.4% of xerostomic patients had normal flow rates, suggests that factors beyond mere volume drive the sensation of dryness. It is hypothesised that qualitative changes in saliva, such as increased viscosity, reduced mucin content, or altered electrolyte composition, may impair mucosal lubrication even when flow rates appear quantitatively normal. Furthermore, in a "Special Care" population with high rates of systemic disease, peripheral neuropathies (associated with diabetes or chemotherapy) may alter oral sensorineural thresholds, leading to a perception of dryness (phantom xerostomia) that persists despite adequate hydration. This underscores the complexity of oral sensation in the elderly and suggests that management strategies must address mucosal hydration and lubrication quality, not merely the stimulation of fluid volume.

Our findings further reinforce the growing body of evidence demonstrating that xerostomia and hyposalivation, although related, represent distinct clinical entities. This dissociation has been previously demonstrated in a population-based study of older adults in Mexico, in which only a minority of participants exhibited both conditions simultaneously, and xerostomia was not significantly associated with objectively measured hyposalivation. These observations highlight the limitations of relying solely on patient-reported dry mouth symptoms to identify underlying salivary gland hypofunction, particularly in older populations with complex systemic and socioeconomic profiles[29].

4.2 The Polypharmacy Paradox: Quality vs. Quantity

Perhaps the most striking and counter-intuitive finding of this study is the inverse relationship observed between medication count and hyposalivation. Conventional geriatric dentistry principles and numerous epidemiological studies posit that polypharmacy (concurrent use of ≥ 5 medications) is a primary linear predictor of salivary dysfunction. However, our data indicated a statistically significant association ($p = 0.041$) in the opposite direction: participants taking fewer than five medications had a significantly higher prevalence of hyposalivation (34.3%) compared to those with established polypharmacy (6.7%).

This "Polypharmacy Paradox" challenges the utility of simple "pill counts" as a risk assessment tool and strongly supports the "Anticholinergic Burden" hypothesis. It suggests that the pharmacodynamic profile (quality) of the medication is far more critical than the quantity. A patient prescribed a single, potent xerogenic agent, such as a tricyclic antidepressant (e.g., amitriptyline) or a high-potency antipsychotic (e.g., quetiapine) may suffer profound muscarinic blockade and resultant hyposalivation, despite a low total drug count. In contrast, patients with multimorbidity managed on complex polypharmacy regimens (e.g., 5–10 drugs) may be under stricter medical surveillance. Their regimens often consist of cardio-protective or metabolic agents (e.g., statins, aspirin, metformin) which, while numerous, possess low xerogenic potential.

Furthermore, the "Special Care" context may imply that patients with extensive polypharmacy are receiving more holistic medical management, potentially including medication reviews that substitute highly anticholinergic drugs with safer alternatives. Conversely,

patients with fewer diagnoses may be on older, less selective medications for specific conditions (e.g., older generation antihistamines or bladder antispasmodics) that carry a heavier secretomotor penalty. Clinically, this dictates a paradigm shift: dental practitioners should strictly evaluate the xerogenic potency of specific drug classes, prioritizing the identification of anticholinergics and sympathomimetics rather than being reassured by a low total number of prescriptions.

4.3 Systemic Disease Trends

Oncology and Renal Implications While sociodemographic factors showed no significant impact on salivary outcomes, systemic disease profiles revealed clinically relevant trends. Although failing to reach strict statistical significance ($p = 0.053$), the association between oncology-related conditions and severe xerostomia is clinically profound. One-third of cancer survivors in this cohort presented with "Severe Xerostomia," the highest proportion among all disease groups. This likely reflects the irreversible damage to acinar cells and the fibrosis of glandular architecture caused by head and neck radiotherapy or cytotoxic chemotherapy. In these patients, the damage is often structural and permanent, involving not just the secretory units but also the vascular supply and parasympathetic innervation, rendering standard sialogogues less effective.

Similarly, a notable trend was observed in patients with renal disease, where 66.7% exhibited hyposalivation. This association is mechanistically plausible; chronic kidney disease (CKD) often necessitates fluid restriction and diuretic use, leading to systemic dehydration and reduced plasma volume available for saliva production. Furthermore, uremic toxicity can induce direct glandular neuropathy or autonomic dysfunction. While the small sample size ($N = 50$) likely limited the statistical power to confirm these associations ($p > 0.05$), the upward trends in oncology and renal patients warrant close clinical attention. In a Special Care setting, these patients represent a "red flag" group requiring aggressive prophylactic management for hyposalivation-induced caries, independent of their current symptom reporting.

4.4 Special Care Dentistry Context and Multidisciplinary Care

The demographic profile of the study population distinguishes these findings from general population surveys. With 76% of participants classified as dependent in Activities of Daily Living (ADL) and 94% presenting with multimorbidity, this cohort represents the frailest segment of the elderly population. The high prevalence of xerostomia (84%) in this group is likely exacerbated by this dependency. Patients with reduced manual dexterity or cognitive impairment (e.g., dementia) may struggle with oral hygiene and hydration, compounding the effects of reduced salivary flow.

The findings highlight that in Special Care Dentistry, salivary dysfunction is not merely an oral nuisance but a marker of systemic and pharmacological burden. The disconnect between symptoms and signs, and the specific impact of high-potency medications, underscores the necessity for multidisciplinary care. Management of these patients cannot occur in a dental silo; it requires communication with prescribing physicians to explore the deprescribing of potent anticholinergics or the substitution of xerogenic drugs where systemically safe. Furthermore, given the high dependency levels, preventive strategies must be passive and caregiver-supported, such as the use of high-fluoride varnishes and artificial salivary substitutes, as these patients may lack the autonomy to manage their own symptoms effectively.

4.5 Strengths and Limitations

This study’s primary strength lies in its integrative methodology within a real-world clinical setting. By utilizing both validated patient-reported outcome measures (SXI-D) and standardized sialometry (UWS) in a specialized clinic, the study provides a granular view of a hard-to-reach population often excluded from large epidemiological surveys. The rigorous exclusion of bias through systematic random sampling and the detailed categorization of medication types (rather than simple counts) adds robustness to the analysis of pharmacological risk factors.

However, limitations must be acknowledged. The cross-sectional design precludes the determination of causality, particularly regarding the temporal relationship between medication initiation and symptom onset. The sample size of 50, while sufficient for a pilot exploration in a specialized setting, limited the statistical power to detect subtle associations in regression models, evidenced by the wide confidence intervals in the logistic regression analysis. Additionally, the reliance on unstimulated saliva alone, while safer for this frail cohort, omits data on glandular functional reserve that stimulated sialometry could provide. Finally, the exclusion of patients lacking cognitive capacity to consent (though ethically necessary) potentially excluded the most severely impaired segment of the Special Care population, who might bear the highest burden of oral disease.

4.6 Conclusion

This study establishes that while xerostomia is ubiquitous among older adults in the Special Care Dentistry setting, it is not an accurate proxy for objective hyposalivation. The discordance observed, where 84% of patients reported symptoms but only 26% exhibited measurable signs challenges the reliance on patient-reported outcomes alone. Critically, the identification of asymptomatic hyposalivation in 12.5% of the "non-complaining" cohort represents a significant latent risk. In a Special Care population characterized by high Activities of Daily Living (ADL) dependency (76%) and cognitive frailty, these "silent" hyposalivators are unlikely to self-advocate or maintain adequate oral hygiene, placing them at imminent risk for rapid caries progression and mucosal infections. Consequently, this study advocates for the mandatory integration of objective sialometry into routine geriatric dental assessments, ensuring that glandular hypofunction is diagnosed before irreversible oral damage occurs.

Furthermore, our findings fundamentally challenge the traditional "polypharmacy dogma" within the context of medically complex care. The observation that hyposalivation was significantly more prevalent in patients taking fewer than five medications suggests that in Special Care Dentistry, the *quality* (pharmacodynamic profile) of the medication burden outweighs the *quantity*. Patients in this setting are frequently managed with high-potency xerogenic agents, such as antipsychotics, tricyclic antidepressants, or urological antispasmodics, which can induce profound salivary blockade even as monotherapies. Therefore, the clinical focus must shift from simple medication counting to a nuanced evaluation of the anticholinergic burden, necessitating closer collaboration between dental specialists and geriatricians to explore de-prescribing or substituting high-risk agents.

Ultimately, salivary dysfunction in the older adults is not merely a quality-of-life issue but a marker of systemic and pharmacological strain. Effective management in this vulnerable cohort requires a paradigm shift from passive symptom relief to active, multidisciplinary intervention. This includes regular quantitative monitoring of salivary flow, aggressive preventive remineralization therapies for dependent patients, and interprofessional medication reviews. Future research should prioritize longitudinal studies to map the trajectory of salivary decline in relation to specific anticholinergic loads, establishing evidence-based protocols that protect the oral integrity of the ageing, medically compromised population.

Declarations

Author Contribution

Min Fern Chan (M.F.C) completed data collection and analysis.Aisyah Ahmad Fisal (A.A.F.) refine the literature review.Jessica Francis (J.F) supervised and finalised the manuscript.All authors reviewed the manuscript.

Data Availability

All data generated or analysed during this study are included in this published article and its supplementary information files.

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Supplementary Files

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