

Risk factors and symptoms associated with xerostomia: a cross-sectional study

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ABSTRACT

Background: The aim of this study was to examine the symptoms and risk factors associated with self-reported xerostomia.

Methods: Data were collected from 601 self-administered questionnaires among dental clinic attendees. Logistic regression models to estimate odds ratios and 95% confidence intervals were used to investigate the association for exposures of interest, such as socio-demographic characteristics, self-reported symptoms, oral hygiene habits and xerostomia.

Results: Participants reported having dry mouth in 19.6% of cases. Xerostomia was associated with a significant increase in the odds of having dry lips, throat, eye, skin and nose. Patients with self-reported xerostomia were three times more likely to drink water to swallow food than were patients without xerostomia. Older individuals were significantly more likely to report dry mouth, and the prevalence of xerostomia increased with advancing age. The prevalence of xerostomia in patients taking one or more drugs was significantly higher compared to medication-free patients, and increased with increasing numbers of medications used. Finally, individuals with a nervous or mental disorder, or who wore removable dentures were five times more likely to develop xerostomia than patients without disorder or dentures.

Conclusions: Dentists should be familiar with the symptoms of xerostomia and be prepared to take an active role in the diagnosis, management and treatment of the oral complications.

Keywords: Xerostomia, medication, symptoms.

Abbreviations and acronyms: OR = odds ratio; SGH = salivary gland hypofunction.

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INTRODUCTION

Xerostomia is a common subjective complaint of dryness in the mouth¹ and is distinctly different to alterations in salivary flow rate (usually described as salivary gland hypofunction, SGH). These two conditions are not necessarily related; several studies show that people can have SGH, but do not report symptoms of dry mouth (xerostomia), and similarly people who report xerostomia may have normal or high salivary flow.² Xerostomia affects people socially and emotionally, and may reduce their quality of life.³ The presence of xerostomia with a low or altered salivary flow may place patients at a higher risk of dental caries, gingivitis, erosion and ulceration of mucosal tissues, oral candidiasis, dysgeusia and dysphagia.^{4,5} A reduction of saliva may lead to complaints of dry mouth, halitosis and oral burning sensation. Other manifestations may include

an increasing aversion to dry foods, difficulty with swallowing dry foods, or increased need to sip or drink water when swallowing.⁶ In addition, the wearing of dentures is severely complicated.⁷

The major causes of xerostomia among dental patients are the use of medications, and head and neck radiation therapy.⁴ Radiotherapy may lead to sialadenitis, parenchymal loss, and then to xerostomia. The extent of involvement is dependent upon the radiation dose received, the time over which the dose was received, the area and volume irradiated, the energy of the radiation and the type of radiation. Both stimulated and resting saliva volumes are decreased by radiotherapy but some improvement can be expected over time. Similarly, the severity of dry mouth increases with increasing duration of treatment, number of medications used and dosage. Other possible causes of dry mouth include uncontrolled diabetes,

chronic graft-versus-host disease, Sjögren's syndrome, vasculitis, dehydration, malnutrition, psychogenic conditions and immunodeficiencies.^{8,9} The evidence for chemotherapy or normal ageing as causative factors is still controversial.

The symptomatic management of xerostomia involves the use of saliva stimulants, saliva substitutes, oral lubricants, non-irritating toothpaste, sugarless sweets containing citric and malic acid, chewing gums, pilocarpine and increased fluid intake.¹⁰

Xerostomia represents a serious problem with medical and oral consequences. As such, dentists can identify early symptoms to improve patient oral comfort and function. The aim of this study was to investigate the perception of dry mouth among dental patients and explore the possible risk factors and symptoms associated with this condition.

MATERIALS AND METHODS

Study population and recruitment

From September 2009 to June 2010, patients were recruited from the Unit of Oral Diagnosis at the University of Milan, Italy and were invited to complete a questionnaire. Participants were selected sequentially based on the following inclusion criteria: (1) aged 18 years or older; and (2) ability to read, understand and answer the questionnaire. All patients signed informed consent documents.

The questionnaire

All patients received the same questionnaire at the dental clinic; although the questionnaire was self-administered, a dental student was available if any question(s) arose. The first section of the questionnaire collected socio-demographic information including gender, country of birth, age, education level, tobacco and alcohol habits, and self-reported medical history. Medication data were collected asking for the name of drug(s) taken daily. The second section assessed oral hygiene such as daily use of toothpaste, dental floss, inter-dental brush and mouthwash. The third section of the questionnaire asked patients if they had any oral lesion(s) or experienced burning mouth, dry mouth and/or halitosis. They were also asked to report the frequency, severity and duration of dry mouth symptoms. Responses for these items were 'never', 'seldom', 'sometimes' and 'often'. Another question assessed whether participants wore a removable denture. Finally, the last section queried whether the participant had dry lips, throat, eyes, skin and/or nose. In addition, patients were asked to report if they woke up at night to drink water and/or if they drank water to facilitate swallowing.

Statistical analysis

The distribution of socio-demographic characteristics, tobacco smoking (current smokers) and alcohol consumption (more than two drinks per day), medical history, oral hygiene habits and symptoms and oral conditions were evaluated. Age was divided into quartiles. Education was measured as the highest level of education achieved, which we described in four categories: (1) five years of school (primary school); (2) eight years of school (junior high school); (3) 13 years of school (high school); and (4) some college education or more (14 years or more of school).

Given the possible association between age and xerostomia, socio-demographic characteristics, smoking and alcohol consumption, medication and diseases, oral hygiene habits and self-reported symptoms were stratified by age (Tables 1 and 2).

Patients reported the name(s) of medication(s) they were taking. Antihypertensives, anticholinergics, antipsychotics, anti-inflammatory medications, bronchodilators and antidepressants are the most common drugs that can interfere with salivary secretion and composition.¹¹ We then identified all the xerogenic medications and created a dichotomous variable for daily medication intake. 'Dry mouth' was evaluated overall and then stratified by duration and frequency.

We used logistic regression models to estimate odds ratios (OR) and 95% confidence intervals (CI) to investigate the association of exposure of interest, such as participants' characteristics and self-reported symptoms with the primary outcome (dry mouth). We fitted the initial full model with all of the participants' characteristics, then reduced the model sequentially by removing variables whose results were not significant at the $p = 0.20$ level. Heterogeneity was assessed by use of the χ^2 test. All p -values reported were considered statistically significant at $p < 0.05$.

RESULTS

A total of 601 questionnaires were collected (296 males). Overall, patients ranged in age from 18 to 88 years, with a median age of 47 (interquartile range 32–63 years). The majority of participants were Italian (90.0%). Around 21% of patients completed university, 48.2% had a high school diploma, 21.4% completed junior high school and 8.8% reported five years of education. Approximately 28% of the study population reported current smoking, and alcohol consumption was reported by 61.2% of subjects (Table 1). Among current smokers, 43.2% smoked from 0 to 5 cigarettes per day, 24% smoked 6–15 cigarettes per day and 32.3% reported smoking more than 15 cigarettes daily. Nearly 49% were taking systemic medication. Daily medication use and daily

Table 1. Socio-demographic characteristics and medical history

Socio-demographic data	Total n (%)	Age category n (%)				P for trend
	(N = 601)	18–35 (N = 176)	36–50 (N = 153)	51–60 (N = 101)	60+ (N = 167)	
Gender						
Female	304 (50.7)	72 (40.9)	86 (56.2)	50 (50.0)	94 (56.3)	<0.05
Male	296 (49.3)	104 (59.1)	67 (43.8)	50 (50.0)	73 (43.7)	
Country of birth						
Italy	541 (90.0)	152 (86.4)	121 (79.1)	97 (96.0)	167 (100.0)	<0.01
Other ^a	60 (10.0)	24 (13.6)	32 (20.9)	4 (4.0)	0 (0.0)	
Education (years)						
5	53 (8.8)	2 (1.1)	3 (2.0)	7 (7.0)	41 (24.7)	<0.01
8	128 (21.4)	41 (23.4)	27 (17.8)	25 (25.0)	35 (21.1)	
13	288 (48.2)	19 (10.9)	38 (25.0)	30 (30.0)	38 (22.9)	
14 or more	128 (21.4)	113 (64.6)	84 (55.3)	38 (38.0)	52 (31.3)	
Medical history						
Current smoker						
No	436 (72.5)	68 (40.9)	39 (25.5)	37 (36.6)	21 (12.6)	<0.01
Yes	165 (27.5)	108 (59.1)	114 (74.5)	64 (63.4)	146 (87.4)	
Cigarettes/day						
0–5	70 (43.5)	36 (53.7)	10 (25.6)	15 (41.7)	9 (47.4)	0.1
6–15	39 (24.2)	16 (23.9)	15 (38.5)	15 (41.7)	6 (31.6)	
15+	52 (32.3)	15 (22.4)	14 (35.9)	6 (16.7)	4 (21.1)	
Alcohol consumption						
Never	224 (38.8)	51 (40.9)	66 (44.6)	31 (33.3)	74 (45.7)	<0.01
Yes*	353 (61.2)	119 (59.1)	82 (55.4)	62 (66.7)	88 (54.3)	
Medication intake						
No	360 (59.1)	155 (40.9)	108 (70.6)	66 (65.3)	28 (16.8)	<0.01
Yes	241 (40.9)	21 (59.1)	45 (29.4)	35 (34.7)	139 (83.2)	
Number of medications/day						
1	90 (38.2)	13 (68.4)	23 (53.5)	18 (51.4)	35 (25.4)	<0.01
2–3	81 (34.3)	4 (21.1)	12 (27.9)	6 (17.1)	59 (42.8)	
>3	65 (27.5)	2 (10.5)	8 (18.6)	11 (31.4)	44 (31.9)	
Diseases						
Hypertension	120 (20.0)	0 (0.0)	12 (19.4)	23 (39.0)	85 (38.6)	<0.01
Cardiovascular	58 (9.7)	3 (21.4)	9 (14.5)	9 (15.3)	36 (16.4)	
Diabetes	39 (7.7)	3 (21.4)	8 (12.9)	5 (8.5)	22 (10.0)	
Thyroid	39 (7.7)	2 (14.3)	13 (21.0)	8 (13.6)	16 (7.3)	
Nervous or mental	19 (7.5)	1 (7.1)	5 (8.1)	1 (1.7)	12 (5.5)	
Osteoporosis	34 (5.7)	0 (0.0)	1 (1.6)	6 (10.2)	26 (11.8)	
Liver	18 (3.6)	1 (7.1)	5 (8.1)	5 (8.5)	6 (2.7)	
Blood	15 (2.5)	2 (14.3)	5 (8.1)	1 (1.7)	7 (3.2)	
Lung	10 (1.7)	2 (14.3)	2 (3.2)	0 (0.0)	6 (2.7)	
Kidney	7 (1.2)	0 (0.0)	2 (3.2)	1 (14.3)	4 (57.1)	

^aDue to small sample size America, Asia and Australia were collapsed into 'Other' category.

*Alcohol consumption was defined as consuming an average of more than 2 glasses per day.

number of drugs increased significantly with age (data not shown). Hypertension was present in 20.0% of individuals. Less than 10.0% of patients were affected by cardiovascular disease, followed by diabetes (7.7%), thyroid (7.7%), nervous or mental disorder (7.5%) and osteoporosis (5.7%).

When oral hygiene habits were considered (Table 2), the majority of individuals (95.6%) brushed their teeth with toothpaste, 23.3% reported daily dental flossing, and 34.4% used mouthrinsing products. Nearly 10.0% of patients reported wearing a removable denture. Oral lesions were present in 10.1% of individuals. Participants most frequently reported having dry mouth (19.6%); the reported burning sensation and halitosis were 9.0% and 13.1%, respectively. In stratified analysis, when age was considered, significant differences were observed for socio-demographic data,

medical history (Table 1), some oral hygiene habits and self-reported oral symptoms (Table 2). Xerostomia was reported by the majority of the individuals (57.0%) to occur during the day and by 45.3% seldom to occur; the sensation of dryness in 51.4% of patients decreased while eating (data not shown). Detailed data on the frequency of other symptoms that were considered relevant to xerostomia are reported in Table 3.

Dry mouth sensation was associated with a significant increase in the odds of having dry lips, dry throat, dry eyes, dry skin and dry nose (Table 3). Compared to patients without xerostomia, patients with xerostomia were three times more likely to drink water to swallow food (OR: 3.2, 95% CI 1.8–5.7) and around five times more likely to have an oral lesion (OR: 4.6, 95% CI 2.6–7.9). Older individuals were significantly more likely to report dry mouth compared to those who were

Table 2. Oral hygiene habits, symptoms and conditions of Italian dental patients

Oral hygiene habits	Total <i>n</i> (%)	Age category <i>n</i> (%)				P for trend
	(<i>N</i> = 601)	18–35 (<i>N</i> = 176)	36–50 (<i>N</i> = 153)	51–60 (<i>N</i> = 101)	60+ (<i>N</i> = 167)	
Daily use of toothpaste						
No	27 (4.4)	4 (2.3)	5 (3.3)	3 (3.0)	14 (8.4)	<0.05
Yes	574 (95.6)	172 (97.7)	148 (96.7)	98 (97.0)	153 (91.6)	
Daily use of dental floss						
No	461 (76.7)	124 (70.5)	114 (74.5)	82 (81.2)	138 (82.6)	<0.05
Yes	140 (23.3)	52 (29.5)	39 (25.5)	19 (18.8)	29 (17.4)	
Daily use of inter-dental brushes						
No	568 (94.5)	175 (99.4)	148 (96.7)	93 (92.1)	148 (88.6)	<0.01
Yes	33 (5.5)	1 (0.6)	5 (3.3)	8 (7.9)	19 (11.4)	
Daily use of mouthwash						
No	375 (65.6)	129 (75.4)	93 (63.3)	62 (64.6)	90 (58.1)	<0.01
Yes	197 (34.4)	42 (24.6)	54 (36.7)	34 (35.4)	65 (41.9)	
Oral conditions and symptoms						
Wearing removable denture						
No	543 (90.4)	176 (100.0)	152 (99.3)	87 (86.1)	124 (74.3)	<0.01
Yes	58 (9.6)	0 (0.0)	1 (0.7)	14 (13.9)	43 (25.7)	
Self-reported oral lesion(s)						
No	540 (89.9)	172 (97.7)	137 (89.5)	91 (90.1)	136 (81.4)	<0.01
Yes	61 (10.1)	4 (2.3)	16 (10.5)	10 (9.9)	31 (18.6)	
Self-reported burning mouth						
No	547 (91.0)	166 (94.3)	135 (88.2)	91 (90.1)	151 (90.4)	0.27
Yes	54 (9.0)	10 (5.7)	18 (11.8)	10 (9.9)	16 (9.6)	
Self-reported halitosis						
No	522 (86.9)	156 (88.6)	126 (82.4)	84 (83.2)	153 (91.6)	0.05
Yes	79 (13.1)	20 (11.4)	27 (17.6)	17 (16.8)	14 (8.4)	

younger ($p < 0.01$), and the risk of having xerostomia increased with increasing age (Table 4). The prevalence of xerostomia in patients taking one or more drugs was 2.2 higher compared to medication-free patients (OR: 2.2, 95% CI 1.5–3.4), and increased with increasing number of medications used (16.7% vs. 33.3% vs. 36.9%; $p < 0.01$). Finally, individuals with a nervous or mental disorder, or those who wore removable dentures were five times more likely to report xerostomia (OR: 5.4, 95% CI 1.9–14.7 and OR: 5.1, 95% CI 2.9–8.9, respectively) than patients without disorder or dentures.

None of the patients received radiation or chemotherapy. No significant associations were observed for the following variables: gender, education, smoking and alcohol consumption, hypertension, cardiovascular diseases, diabetes, thyroid diseases, osteoporosis, liver diseases, blood disorders, lung and kidney diseases, oral hygiene habits, and burning mouth sensation or halitosis.

DISCUSSION

This study investigated the prevalence of and risk factors for dry mouth among a large number of dental patients. Self-reported xerostomia was present in about 20% of individuals, and the sensation of oral dryness increased significantly with age. This is probably due to

a higher number of medications taken among the elderly compared to younger individuals.^{12,13} Firstly, our results show that there was a significant increase in self-reported xerostomia with increasing number of xerostomic medications being taken. This confirms what has been reported previously in other studies.^{14–16} Therefore, the geriatric population is more likely to be affected by dry mouth. Of note, dry mouth symptoms significantly increased in patients affected by mental or nervous disorders. It may be that these individuals took antipsychotic, tricyclic antidepressant, anxiolytic, sedative or anticonvulsant medications, which are well known for their antisialologic effects and thus cause dry mouth.² Secondly, the logistic regression suggests that there was an association between age and xerostomia independent of the effects of the number of medications.

Drug-induced xerostomia has been reported to contribute to difficulty with swallowing and chewing.^{6,17} Our findings show that patients with a dry mouth sensation were three times more likely than those not reporting xerostomia to drink water to swallow certain foods. Patients with swallowing complaints may exhibit lower saliva production rates than those without complaints.¹⁸ As such, in order to compensate the reduced amount of saliva, individuals usually feel the urge to drink frequently while they eat. Also, xerostomia was strongly correlated with

Table 3. Relation of dry mouth risk and self-reported symptoms and habits

	Total	Dry mouth		Odds Ratio (95% CI)	P value
		No	Yes		
Dry lips					
No	124 (49.2)	99 (79.8)	25 (20.2)	1.0	<0.01
Yes	128 (50.8)	73 (57)	55 (43)	2.9 (1.7–5.2)	
Dry throat					
No	157 (62.3)	126 (80.3)	31 (19.7)	1.0	<0.01
Yes	95 (37.7)	46 (48.4)	49 (51.6)	4.3 (2.5–7.6)	
Dry eyes					
No	185 (73.4)	137 (74.1)	48 (24.9)	1.0	<0.05
Yes	67 (26.6)	35 (52.2)	32 (47.8)	2.6 (1.5–4.7)	
Dry skin					
No	158 (62.7)	124 (78.5)	34 (21.5)	1.0	<0.01
Yes	94 (37.3)	48 (41.9)	46 (48.9)	3.5 (2.0–6.1)	
Dry nose					
No	175 (69.4)	134 (76.6)	41 (23.4)	1.0	<0.01
Yes	77 (30.6)	38 (49.4)	39 (50.6)	3.3 (1.9–5.9)	
Wake up to drink water					
No	135 (53.6)	98 (72.6)	37 (27.4)	1.0	0.11
Yes	117 (46.4)	74 (63.2)	43 (36.8)	1.5 (0.9–2.6)	
Drink water to facilitate swallowing					
No	181 (71.8)	137 (75.7)	44 (24.3)	1.0	<0.01
Yes	71 (28.2)	35 (49.3)	36 (50.7)	3.2 (1.8–5.7)	
Self-reported oral lesion(s)					
No	540 (89.9)	451 (83.5)	89 (16.5)	1.0	<0.01
Yes	61 (10.1)	32 (52.5)	29 (47.5)	4.6 (2.6–7.9)	

wearing removable dentures. Niedernicier and colleagues¹⁹ reported that individuals who wore dentures continuously showed significantly severe signs of inflammation compared to a control group without dentures. Thus, the consequent reduction rate of saliva secretion from palatal salivary glands contributes to xerostomia.

Our findings suggest that patients suffering from xerostomia may experience dry lips, throat, eyes, skin and nose. These symptoms could alert the dentist to a more serious problem, such as Sjögren's syndrome. Sjögren's syndrome is a systemic autoimmune disease characterized by chronic inflammation and subsequent destruction of the exocrine glands, including those found in the nose, skin, vagina, and respiratory and gastrointestinal tracts.²⁰ Dentists may be the first health care providers to encounter the early signs of Sjögren's syndrome. Therefore, they should be familiar with the manifestations of the disease and be prepared to take an active role in the diagnosis, management and treatment of the oral complications, and eventually consult a rheumatologist if the symptoms persist.

This cross-sectional study has its limitations. First, approximately half of the participants did not answer the section of the questionnaire that asked whether they had dry lips, throat, eyes, skin, and/or nose. Therefore, it is possible that some clinically important associations were not detected because of the low numbers of remaining respondents. Second, our study population was recruited from a dental clinic nested within tertiary

Table 4. Multivariate analysis of associations with dry mouth

	Dry mouth		Odds Ratio (95% CI)	P value
	No	Yes		
Age category				
18–35	153 (86.9)	23 (13.1)	1.0	<0.01 ^a
36–50	134 (87.6)	19 (12.4)	0.9 (0.5–1.8)	
51–60	75 (74.3)	26 (25.7)	2.3 (1.2–4.3)	
60+	117 (70.1)	50 (29.9)	2.8 (1.6–4.9)	
Alcohol consumption				
No	172 (76.8)	52 (23.2)	1.0	0.16
Yes	288 (81.6)	65 (18.4)	0.8 (0.5–1.1)	
Medication intake				
No	308 (85.6)	52 (14.4)	1.0	<0.01
Yes	175 (72.6)	66 (27.4)	2.2 (1.5–3.4)	
Number of medications/day				
1	75 (83.3)	15 (16.7)	1.0	<0.01 ^a
2–3	54 (66.7)	27 (33.3)	2.5 (1.2–5.1)	
>3	41 (63.1)	24 (36.9)	2.9 (1.4–6.2)	
Liver disease				
No	386 (78.9)	103 (21.1)	1.0	0.07
Yes	11 (61.1)	7 (38.9)	2.4 (0.9–6.3)	
Blood disease				
No	473 (80.7)	113 (19.3)	1.0	0.17
Yes	10 (66.7)	5 (33.3)	2.1 (0.7–6.2)	
Nervous or mental disorder				
No	166 (71.2)	67 (28.8)	1.0	<0.01
Yes	6 (31.6)	13 (68.4)	5.4 (1.9–14.7)	
Osteoporosis				
No	460 (81.1)	107 (18.9)	1.0	0.06
Yes	23 (67.6)	11 (32.4)	2.1 (1.0–4.3)	
Daily use of mouthwash				
No	308 (82.1)	67 (17.9)	1.0	0.05
Yes	148 (75.1)	49 (24.9)	1.5 (1.0–2.3)	
Wearing removable denture				
No	454 (83.6)	89 (16.4)	1.0	<0.01
Yes	29 (50.0)	29 (50.0)	5.1 (2.9–8.9)	

^aP-value for trend.

referral centres. Thus, the results of this study likely represent an overestimate of the prevalence of self-reported xerostomia. Population-based studies are then warranted.

In conclusion, dentists should carefully review patients' medical history. Life expectancy has greatly increased in the last century and there will be increasing numbers of people with acute and chronic diseases;²¹ the changes that occur with ageing make people more likely to suffer medication-related problems.²² Our study underlines the importance of evaluating the use of xerostomic medication, especially in elderly individuals, and asking xerostomia-related questions as part of the dental history. This is extremely important given that 1 in 5 patients suffer from this problem. Oral health care practitioners have the unique opportunity to detect xerostomia and provide appropriate treatment towards improved well-being.

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