



Common Precipitating Factors of Xerostomia in Elderly

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Abstract

Xerostomia is a subjective sign of dry mouth that may or may not be accompanied by objective signs of hyposalivation. The condition of xerostomia has been associated with increasing age in line with the aging process, with a global prevalence of 30% in the elderly aged 65 years and above. This can have an impact on the health and quality of life of the elderly. Also, xerostomia is the most common symptom in patients during periods of anxiety, stress, depression, radiotherapy, chemotherapy, and systemic diseases, as well as in individuals who have a history of polypharmacy or who use certain drugs. This study aimed to review the most recent available evidence regarding the most common causes of xerostomia in the elderly. The PCC strategy (population, context, and concept) was used as a guide for retrieving the relevant articles for this scoping review. Two databases were systematically searched using PubMed and Scopus. The draft of the scoping review and assessment of the methodological quality of the trials was carried out following the criteria of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). A total of 12 trials were identified that met the previously defined selection and quality criteria; 9 related to medicine, and 4 included populations in which xerostomia was a systemic disease, rheumatic disease, radiation therapy to the head or neck region, nutrition, and psychological factors. The common precipitating factor of xerostomia in the elderly is medicine. Drugs that are more commonly found to cause xerostomia are gastrointestinal drugs, psychotropic drugs, and antihypertensive drugs.

Keywords

- ▶ dry mouth
- ▶ xerostomia
- ▶ elderly
- ▶ geriatric
- ▶ human and health

Introduction

Saliva plays an important role in oral health. It does not only protect against bacteria and fungi, but also transports nutrients and digestive enzymes, lubricates the mucosa, facilitates mastication, swallowing, and speech, and acts in the process of tooth remineralization. Saliva is produced by

major and minor salivary glands, which are exocrine. The major salivary glands are parotid glands, submandibular glands, and sublingual glands.¹ These are the most important pairs of glands and are responsible for 95% of saliva production, whereas, the minor salivary glands can be found along the aerodigestive tract and are most concentrated in the

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buccal mucosa, labial mucosa, lingual mucosa, soft or hard palate, and floor of the mouth.²

Xerostomia or dry mouth is a condition caused by insufficient or complete lack of saliva production.³ Xerostomia is the most common symptom in patients during periods of anxiety, stress, depression, radiation therapy, chemotherapy, and systemic diseases, as well as in individuals who have a history of polypharmacy or who use certain drugs. Xerostomia is also a fairly common condition in the elderly. Commonly, dryness of the mouth is naturally experienced at the age of ≥ 65 years and affects at least 30% of all elderly people.⁴ This can have an impact on the general health of the elderly, oral health, and well-being.⁵ Xerostomia may negatively affect oral health-related quality of life such as halitosis, impaired chewing and swallowing, and difficulties in prosthesis retention.⁶ This condition can also have an impact on other health problems such as digestive problems, weight loss, cough, and various oral complications including periodontitis and tooth decay.⁷

Xerostomia has a variety of symptoms, such as cracked peeled atrophic lips, glossitis, progressive cervical, or cusp tip caries even with optimum oral hygiene, candidiasis, and pale corrugated dry buccal mucosa.⁴ Although it is multifactorial, the diagnosis can be made based on various test methods, such as medical history, oral examination, and saliva measurement. Knowledge about xerostomia that occurs in the elderly is important for all healthcare professionals who deal with the elderly.⁵ This study aimed to systematically review the most recent available evidence regarding the most common causes of xerostomia in the elderly.

Methods and Materials

The inclusion criteria used in this review are original articles, research on factors predisposing to the elderly to xerostomia, research published in English from July 1991 to September 2021, complaining of dry mouth either from the consumption of possibly xerostomia drugs or other possibilities. The PCC strategy⁸ namely population, context, and concept was used as a guide for retrieving the relevant articles for this review (►Table 1).

A literature search was performed using databases from PubMed and Scopus on September 16, 2022. The filter available in PubMed, the search was limited to “Observational Study,” “Randomized Controlled Trial,” and “Meta-Analysis.” In Scopus, the search was “Article.” Keywords were

based on the following: (Dry Mouth OR Xerostomia AND Elderly OR Geriatric) OR (“Dry Mouth” AND “Elderly”) OR (“Dry Mouth” AND “Geriatric”) OR (“Xerostomia” AND “Elderly”) OR (“Xerostomia” AND “Geriatric”). Review articles, systematic reviews, and studies that did not mention causality were included, and studies that did not match the discussion were excluded.

Results

Study Selection

In the initial search of the PubMed and Scopus databases, 27,441 references were obtained (►Fig. 1). After the first filter, 4,604 papers were obtained. During the review of the titles and abstracts of these papers, the following were discarded: those that did not match the discussion and any duplicates. After classification based on full text was assessed for eligibility, 22 papers were selected. Finally, the 12 selected works were included in the quantitative synthesis.

Study Characteristics

All studies used a cross-sectional study design with a period from 1991 to 2021. This study was held in various countries such as Japan⁹ (11), Brazil¹⁰⁻¹² (1, 4, 12), Norway¹³ (2), United States¹⁴ (9), Finland^{15,16} (3,8), Poland¹ (10), Korea¹⁷ (6), New Jersey¹⁸ (5), and France¹⁹ (7). The number of subjects in the study ranged from 40 to 3,157. Most studies included older individuals with an age range of 60 to 98 years (►Table 2).

Outcome

The prevalence of xerostomia that occurs in the elderly in the study obtained was 10 to 73.5%. The measurement methods

Table 1 Inclusion criteria

Inclusion criteria	
Population	Elderly who has xerostomia.
Concept	Any research on factors predisposition of xerostomia in the elderly complaining of dry mouth either from the consumption of possibly xerostomic drugs, or other possibilities published in English from July 1991 to September 2021.
Context	Original research articles (any method).

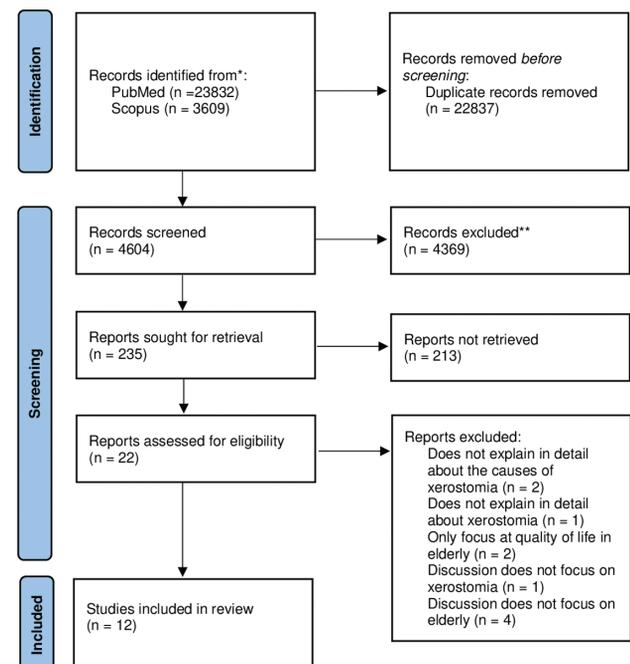


Fig. 1 PRISMA flow chart to demonstrate the methodology applied to selected articles.

Table 2 Sample of eligible studies

No.	Author	Location	Populations	n	Age	Gender	
						Female	Male
1.	Fornari <i>et al</i> ¹⁰	Brazil	The elderly of the municipality of Vanini, which is located in the north-west of the state of Rio Grande do Sul, Brazil.	293	>60	127	166
2.	Diep <i>et al</i> ¹³	Norway	Elderly population in Oslo, Norway	460	65	223	237
3.	Tiisanoja <i>et al</i> ¹⁶	Finland	Community dwelling elderly from the Oral Health GeMS. Research in Kuopio Finland.	152	≥75	109	47
4.	Fernandes <i>et al</i> ¹¹	Brazil	Non-institutionalized elderly was selected during the years of 2017-2018 at the clinic in Brazil	204	>60	123	81
5.	Mao <i>et al</i> ¹⁸	New Jersey	Chinese community dwelling elderly in Chicago	3157	≥60	NR	NR
6.	Lee <i>et al</i> ¹⁷	Korea	NR	120	65-86	NR	NR
7.	Lima <i>et al</i> ¹⁹	France	Elderly patients diagnosed with type 2 diabetes for at least 1 year receiving treatment at the Integrated Center for Diabetes and Hypertension of Ceará (CIHD) in the city of Fortaleza, located in the state of Ceara, Northeastern Brazil.	120	65-91	82	38
8.	Viljakainen <i>et al</i> ¹⁵	Finland	Home care clients elderly living in Eastern and Central Finland	270	≥ 75	192	78
9.	Perrson <i>et al</i> ¹⁴	United States	Elderly living in a nursing home in The United States	40	73-87 (men) 61-98 (woman)	34	6
10.	Kamińska-Pikiewicz <i>et al</i> ¹	Poland	The elderly inhabits the general care home and a comparative group of elderly individuals living at home, but who are outside patients of the Dental Clinical Center, Lublin Medical University.	240	65-96	120	120
11.	Ohara <i>et al</i> ⁹	Japan	Elderly registered on the city's residents file with the consent of the authorities in the Itabashi district located north of Tokyo in October and November 2008.	1286	75-84	1286	–
12.	Leal <i>et al</i> ¹²	Brazil	Elderly that attending Medical Center for the Elderly (MCE) in Brasilia University Hospital	40	60-86	30	10

that were used to determine the condition of xerostomia varied. There were nine studies with subjective measurement that used questionnaires, such as Xerostomia Inventory (XI), Bother Index (BI), FOX questionnaire, and simple questions about xerostomia. Two studies with objective measurements used sialometry and Clinical Oral Dryness Score (CODS) (► **Table 2**).

Within 12 studies, 9 included populations in which xerostomia was drug-induced. Four included populations in which xerostomia was due to systemic diseases, rheumatic disease, radiation therapy to the head/neck region, nutrition, and psychological factors (► **Table 3**). Drug classes associated with the occurrence of xerostomia can be seen in ► **Table 4**.

Discussion

Xerostomia is a common condition in the elderly. It is characterized by subjective dry mouth symptoms. Measurement of xerostomia can be done both subjectively and objectively. Subjective measurement can use various kinds of questionnaires such as Summated Xerostomia Inventory, Xerostomia Questionnaire, and FOX questionnaire.^{1,9-12,15-18} The objective measurement can be done by assessing salivary flow rate (sialometry) or from the clinical condition of the patient using the Clinical Oral Dryness Score (CODS).^{13,19}

Based on the 12 studies included, we obtained a scoping review. We found that the precipitating factors for xerostomia conditions that occur in the elderly include the use of

Table 3 Prevalence, measurement, and predisposition factors of xerostomia

No.	Author	Prevalence of xerostomia	Measurement	Predisposition factors	Type of drugs used
1.	Fornari <i>et al</i> ¹⁰	19,1%	Questionnaire	Systemic diseases and medications	Gastrointestinal drugs
2.	Diep <i>et al</i> ¹³	10%	Sialometry and CODS	Medication use, rheumatic disease, and received radiation therapy to the head/neck region.	NR
3.	Tiisanoja <i>et al</i> ¹⁶	ADS 0 = 77 (10%) ADS 1-2 = 53 (24%) ADS ≥3 = 22 (55%)	Questionnaire	Medication	Anticholinergic
4.	Fernandes <i>et al</i> ¹¹	Xerogenic drugs (23.5%) Antixerogenic drugs (15.2%) Variable interference (73.5%) No evidence of interference (46.6%)	Questionnaire	Medication	Antidiabetic, antihypertensive, (diuretic, ACE inhibitor) corticosteroid, sedatives
5.	Mao <i>et al</i> ¹⁸	25.5%	Questionnaire	Perceived stress, social support	NR
6.	Lee <i>et al</i> ¹²	47,5%	Questionnaire and VAS	Medication, nutrition	Hypertension drugs, diabetic drugs, osteoporotic medication
7.	Lima <i>et al</i> ¹⁹	44 (36.7%)	Sialometry	Medication	Antihypertensive
8.	Viljakainen <i>et al</i> ¹⁵	55.6%	Questionnaire	Medication	Loop diuretics, proton pump inhibitors
9.	Perrson <i>et al</i> ¹⁴	NR	NR	Medication	Psychotropic and diuretic agents
10.	Kamińska-Pikiewicz <i>et al</i> ¹	79 (65.81%)	Questionnaire	Medication	Antihypertensives, sedatives, bronchodilator, anti-dizziness medicines
11.	Ohara <i>et al</i> ⁹	499 (38.8%)	Questionnaire and VAS	Medication	Anti-inflammatory drugs and analgesic
12.	Leal <i>et al</i> ¹²	20 (50%)	Questionnaire	Medication	Antidepressants and antihypertensives

Table 4 Medications associated with xerostomia^{1,9,11,12,14-16,19,22,23}

Drugs classes	Example
Anticholinergic	Atropine, scopolamine
Antihypertensive	Clonidine, guanfacine, reserpine, methyl dopa, timolol, atenolol, metoprolol, diltiazem, verapamil, nifedipine, thiazides, furosemide, chlorothiazide, calcium channel blockers
Antidepressant	Amitriptyline, diazepam
Antipsychotic	Olanzapine, clozapine, haloperidol, quetiapine, risperidone, donepezil, phenothiazine derivatives
Bronchodilator	Salbutamol, terbutaline, sameterol, formoterol, indacaterol, tiotropium, ipratropium
Antihistamine	Diphenhydramine, chlorpheniramine, cetirizine, acrivastine, astemizole, loratadine, mizolastine

drugs, psychological factors such as stress and social support, and systemic conditions. The predominant precipitation factor is the use of drugs, as found in the literature. This is following the previous literature that states that there is a

strong relationship between the use of drugs with xerostomia and salivary gland hypofunction in the elderly.²⁰

There are various kinds of drugs that have been correlated with the condition of xerostomia (► **Table 4**). It is estimated

that as many as more than 400 kinds of drugs can cause xerostomia and affect the function of the salivary glands.^{21–23} Based on our review, the most common types of drugs that are considered to be correlated with xerostomia are antacids and gastrointestinal drugs (two studies), psychotropic drugs (four studies), and antihypertensive drugs (six studies).

Digestive drugs are drugs that are widely consumed by the elderly. It has been found that there is a significant relationship between gastrointestinal drugs and xerostomia conditions, where the elderly who use digestive tract drugs continuously are 2.14 times more likely to experience xerostomia. Therapy for gastrointestinal disease consists of various kinds of drugs, such as antacids, anticholinergics, histamine H2 receptor antagonists (e.g., cimetidine, ranitidine, famotidine, and nizatidine), and muscarinic M1 receptor antagonists (e.g., pirenzepine). This is consistent with the study of Karthik *et al*²⁴ and Tiisanoja *et al*²⁵ where these drugs have a side effect of dry mouth.

Hypertension is one of the blood pressure diseases that often occur in the elderly where they have to take antihypertensive drugs. This is following the above six studies where they took the drug to lower their blood pressure. Antihypertensive drugs also consist of various kinds, one of which is amlodipine. Amlodipine is a calcium channel blockers (CCBs) class of drugs that can cause xerostomia. This can happen because this drug suppresses water secretion by closing the Ca²⁺ channels so that the Cl⁻ door cannot be opened. The Cl⁻ door that does not open causes the intracellular Cl⁻ to not be able to exit through the apical membrane of the acinar cells and water cannot enter the acinar lumen. This mechanism affects the whole saliva, which consists of 99% water, and eventually causes xerostomia.²⁶

Hypnotics is also a drug that is often used by the elderly and can cause side effects of xerostomia. This is consistent with one study,²⁷ where 53% of respondents had used hypnotics in the previous year, prescription products accounting for 83% (66% benzodiazepines, 11% zopiclone, 4% antidepressants, 2% opioids), while 17% of the products used were over-the-counter (5% herbs, 5% antihistamines, 3% analgesics). Hypnotic use was regular (50% daily) and chronic (mean duration 6 years) and most respondents reported adverse drug reactions (ADRs), mainly dry mouth (30%).

Psychological factors such as depression, anxiety, and stress are also common in the elderly. This is proven by a study conducted by Luppa *et al*,²⁸ in which the prevalence rate of depressive symptoms is 17.1% in individuals aged 75 years and over and 19.5% in individuals aged 50 years and over. Anxiety and stress have a significant influence on depression in the elderly because anxiety has an impact on emotional conditions so a person will be easily restless, have mood swings, easy to get angry, be stressed, and have irritability. Prolonged anxiety can cause a person to become anxious and depressed.²⁹ Anxiety and fear may affect salivary secretion through pathways in the amygdala, the hypothalamus, and the brainstem related to xerostomia.³⁰ Depression is often treated using psychotropic drugs, one of which is antidepressant drugs, where these drugs can also cause xerostomia because antidepressant drugs have anti-

cholinergic side effects, namely a decrease in the salivary flow rate by inhibiting the effect of acetylcholine on M3 muscarinic receptors, causing xerostomia.³¹ In addition to antidepressant drugs, other psychotropic drugs such as antipsychotics and anxiolytics or sedatives have also been shown to have a large side effect of xerostomia.³²

The relationship between xerostomia and nutritional intake in the elderly has been mentioned in previous studies. The risk of malnutrition is common in individuals aged 90 years and has been associated with xerostomia conditions.³³ Another study stated that people with xerostomia conditions were found to have poor or low nutrition.³⁴ Further research conducted by Lee *et al*. found that intake of vegetable fat, vitamin E, folate, and water was lower in the group of individuals with xerostomia compared to individuals without xerostomia. This is likely to happen because if the elderly are malnourished, they will be more at risk of developing systemic diseases, which ultimately increase the number of drugs consumed.¹⁷

Diep *et al*. found that head and neck cancer therapy is a significant factor that causes xerostomia in the elderly.¹³ Each year, nearly half of patients diagnosed with head and neck cancer are 65 years old and over. Head and neck cancer can be managed with radiotherapy.³⁵ Patients with head and neck cancer usually get 50 to 70 Gy doses. When the salivary glands are exposed to radiotherapy, it will cause irreversible damage to the salivary glands. The level of radiation that can cause damage to the salivary glands is > 52 Gy, and if the dose given is lower, it will generally cause temporary and reversible effects.³⁶

Conclusion

The common precipitating factor of xerostomia in the elderly is medicine. Drugs that are more commonly found to cause xerostomia are gastrointestinal drugs, psychotropic drugs, and antihypertensive drugs. Further studies are needed to explore the association of drugs with the occurrence of xerostomia.

Authors' Contributions

The authors alone are responsible for the content and writing of the article.

Conflict of Interest

None declared.

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