Prevalence of Xerostomia in Population-based Samples: A Systematic Review

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Abstract

The consequences of xerostomia on oral health have been studied for decades; however, the actual prevalence of this disorder on the general population remains controversial. The purpose of this systematic review was to determine the prevalence of xerostomia in population-based samples. Electronic databases were screened for relevant articles and reference lists of pertinent articles were also hand-searched. Thirteen articles meeting the final inclusion criteria were identified. Based on the definition of xerostomia used in this review, only publications including a subjective diagnosis of the disorder were included. All of the self-reported diagnoses were achieved through a questionnaire either by mail, telephone, interview or self-administered by the patient. There was a variation across papers regarding number and content of the questions as well as guidelines for the diagnosis of xerostomia (i.e. answer yes to one or more than one question). The prevalence of xerostomia in the selected articles ranged from 0.9% to 64.8%. The majority of these studies were performed in Scandinavia. In 9 of the articles, the studied samples were 50 years and older. None of the studies evaluated the prevalence xerostomia among individuals younger than 18 years. Based on these observations, it can be concluded that there is a need for population-based studies on prevalence of xerostomia in regions other than Scandinavia. A standardized protocol to diagnose xerostomia needs to be developed. Patient-perceived treatment needs and impact on quality of life should be included to have a complete picture of public health implications of the disease.

Key Words: xerostomia, prevalence, systematic review

Introduction

Controversy appears to exist regarding the definition of xerostomia, and other relevant terms such as dry mouth and hyposalivation have been used indistinctively in the literature. One commonly accepted clinical definition of xerostomia is the subjective sensation of dry mouth (1). The controversy regarding the meaning of xerostomia arises when dry mouth is indistinctly used for two conditions that are not always linked: xerostomia, defined as an individual subjective feeling of dry mouth and salivary gland hypofunction (SGH), a reduced unstimulated or stimulated salivary flow (2).

The presence of xerostomia may indicate that the salivary output is decreased or altered, placing patients at a higher risk for oral complications. Diverse symptoms and consequences have been associated with xerostomia. Symptoms such as halitosis, soreness, oral burning, and difficulty with swallowing and altered taste sensation have been linked with xerostomia (3). In more serious cases, a scalded sensation in the tongue, pharynx and esophagus has been reported. A significant increase in dental caries, periodontal diseases, and denture discomfort/loss of retention and oral infections like candidiasis might also be expected (4-8).

It is clear that xerostomia represents a serious problem with medical and dental implications. It has a damaging effect on the sufferer in particular and society in general. It affects people at an emotional and social level and deteriorates their overall quality of life (9). The devastating effects of xerostomia have been widely perceived by health professionals and researchers, as manifested by the extensive publications on risk factors, consequences and treatment of xerostomia (10-15).

Presumably, it would be the task of the dental professional to first recognize the symptoms and signs of this condition. Awareness of the prevalence of xerostomia in the general population is very important for the clinical practitioner. As stated by Nedefors, "If objective tests do not confirm the subjective complaints, often the patient's experience is that the symptoms are not taken seriously, many times even denied by the medical and dental professional" (16).

Inconsistency appears to exist in the prevalence of xerostomia reported in diverse populations. This is mostly due to pre-selection of the samples (17-20) and reports of xerostomia on patients affected by certain diseases and/or under pharmacological treatment (21-25). The aim of this systematic review is to consolidate current knowledge on the prevalence of xerostomia in population-based samples.

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Materials and Methods

Selection criteria. *Types of publication* – Only journal articles were included. Letters, editorials, theses, abstracts and other types of publications were excluded. *Types of studies* – Only observational studies (cohorts and cross-sectionals) were included. Clinical trials, case reports, case-control studies, studies of predictors of treatment outcome, and experimental laboratory studies were excluded. *Population* – Only population-based studies encompassing well-defined geopolitical boundaries were selected. Studies on other populations such as occupational groups, clinical populations, individuals living in retirement communities, nursing homes or any extended care facility, dental/medical practices, health centers or education colleges or any sample than could not be considered population-based were excluded. Studies evaluating convenience samples were also considered ineligible. Studies on individuals using medication on a chronic basis or with diagnosed medical conditions such as Sjogren's syndrome, cancer or any other chronic diseases were also excluded, as they could potentially skew the prevalence of xerostomia. *Disease definition* – Xerostomia, self reported dry mouth sensation (1). *Exposure* – Prevalence or frequency of xerostomia.

Search strategy. The selection and specific use of each term inside every database search were made with the help of a senior librarian specializing in health sciences database searches (Table 1). Briefly, epidemiological terms (prevalence, epidemiology, and population studies) were combined with diagnostic terms (xerostomia, dry mouth and hypo-salivation). Publications were retrieved by a computerized search of the following databases: MEDLINE (1966 to February week 3 of 2005); MEDLINE in process (February 28, 2005), Lilacs (February 2005) Pubmed (1966 to week 4 of February 2005), EMBASE (1996 to week 9, 2005), Web of Science (February 28, 2005), and all EBM reviews (Cochrane Database of Systematic Reviews, ASP Journal Club, DARE and CCTR) (to the first Quarter of 2005) databases.

Eligibility of potential studies was determined by reading the title and abstract of each article identified by the different search engines. Based on the abstract information, three authors independently selected the articles to be retrieved. At this stage, any abstract that seemed to report xerostomia in a population-based population was selected. Any discrepancies were settled through discussion. When the abstract failed to provide sufficient information, a reprint of the full paper was obtained.

The final selection was independently completed by all the authors, followed by careful examination of each complete article. The selection criteria were fully applied at this stage. Reference lists of the selected articles were hand-searched for additional relevant publications that may have been missed in the database searches. In cases where specific data were necessary for the discussion, and were not specified in the article, efforts were made to contact the authors to obtain the required extra information.

Results

Forty-four abstracts satisfied the abstract inclusion criteria. After careful evaluation of the articles, thirteen (21, 26-37) were finally considered for this review (Table 2). A flow chart of the selection process can be found on Figure 1, with the inclusion or exclusion criteria described in the Methods Section above being used. Several articles were excluded because they did not satisfy the population criterion (18, 19, 38-60). Additional data on the diagnosis of dry mouth was required for three studies (37, 61, 62). Contact was attempted with the corresponding authors through electronic mail asking for the specific information. Only one of these authors (37) provided the required information. Since additional information was unavailable for the other two studies (61, 62), they were not included in the final discussion.

In some cases, the literature search retrieved more than one study reporting results from the same sample. Only the more detailed and completed report (28, 31, 35, 66) was considered to avoid duplication of results (9, 47, 63-65) which would potentially bias the conclusions.

All of the self-reported diagnoses were achieved through a questionnaire either by mail (21, 30, 34, 36), telephone (32, 33); in the form of an oral interview (26, 28, 29, 31);or written interview (27, 37). There was a variation across papers regarding number and content of the questions as well as guidelines for xerostomic diagnoses (i.e. answer yes to one or more than one question). Seven of the studies also performed an additional objective measurement of salivary gland function (21, 26, 27, 29, 31, 32, 35).

Six studies (46%) were conducted in Scandinavia. Of the 6 studies, 4 were performed in Sweden and 2 in Finland. Most of the data on the prevalence of xerostomia was retrieved from articles studying xerostomia (11 publications, 85%) (26, 27, 28, 29, 30, 31, 32, 33, 35, 55, 67). Two articles provided this information while evaluating the prevalence of oral mucosal lesions (34, 37) and two while assessing oral symptoms in menopause (21, 36).

All the studies evaluated the prevalence of xerostomia grouped by age and gender. The fact that the data were presented in different age group intervals made a direct comparison between studies difficult. In general, prevalence varied according to gender, age and sample origin. In 9 (69%) of the selected articles (21, 26, 27, 28, 29, 31, 33, 36, 37), the population sample consisted of individuals 50 years and older. None of the studies evaluated the prevalence of xerostomia in individuals younger than 18 years old. One of the highest rates of xerostomia in older adults was reported in Helsinki, Finland (29) in 1994 where 46% of 75-, 80-, and 85-year-old individuals complained of dry mouth. The lowest rate was a 0.9% in older German individuals (34).

All the selected articles reported a greater prevalence of xerostomia in

TABLE I
Database search strategy and sensitivity of the electronic databases used

Database	Keywords	Results	Selected	% or total selected abstracts (13)*
PubMed	1) xerostomia (2) hyposalivation; (3) dry mouth; (4) 1 or 2 or 3; (5) prevalenc*; (6) epidemiol*; (7) population stud*; (8) 5 or 6 or 7; (9) 4 and 8; (10) limit human	855	9	69.2%
Medline	(1) xerostomia.mp (2) hyposalivation.mp; (3) dry mouth.mp (4) 1 or 2 or 3; (5) prevalenc$.mp; (6) epidemiol$.mp; (7) population stud$.mp; (8) 5 or 6 or 7; (9) 4 and 8; (10) limit human	254	10	76.9%
Medline In-Process & Other Non-Indexed Citations	(1) xerostomia.mp (2) hyposalivation.mp; (3) dry mouth.mp (4) 1 or 2 or 3; (5) prevalenc$.mp; (6) epidemiol$.mp; (7) population stud$.mp; (8) 5 or 6 or 7; (9) 4 and 8; (10) limit human	10	0	0
Web of Science	TS=(xerost* OR hyposalivation OR dry mouth*) AND TS=(epidemiol* OR prevalenc* or population stud*) DocType=Article; Language=All languages; Database(s)=SCI-EXPANDED.	245	10	76.9%
Embase	(1) xerostomia.mp (2) hyposalivation.mp; (3) dry mouth.mp (4) 1 or 2 or 3; (5) prevalenc$.mp; (6) epidemiol$.mp; (7) population stud$.mp; (8) 5 or 6 or 7; (9) 4 and 8	439	2	15.4%
All EBM reviews	(1) xerostomia.mp (2) hyposalivation.mp; (3) dry mouth.mp (4) 1 or 2 or 3; (5) prevalenc$.mp; (6) epidemiol$.mp; (7) population stud$.mp; (8) 5 or 6 or 7; (9) 4 and 8; (10) limit human	73	1	7.7%
Lilacs	xerostomia AND prevalence	2	0	0

* Percentages do not add up to 100% as the same reference could be found in several databases

females. One study (36) reported prevalence in a female sample only.

All but one (37) of the selected articles was in English.

The diversity of sample size (ranging from 259 to 3,313 individuals) and differences in the assessment of xerostomia, as well as in the result presentation, made these articles unsuitable for a meta-analysis. Therefore, the results presented here are merely descriptive.

Discussion

This systematic review evaluated the results of 13 studies on the prevalence of xerostomia in population-based samples. An electronic literature search was conducted using 6 databases to gather articles in all languages. None of the databases included more than three quarters of the total selected abstracts; therefore, doing a Medline search alone in a systematic review of this topic was not sufficient to reveal all the related abstracts. Every effort was made to locate published population-based reports on prevalence of xerostomia.

Although xerostomia and hyposalivation refer to two different entities, as was discussed in the introduction to this review, hyposalivation was included as one of the search terms in an attempt to prevent the omission of relevant information. Significant disagreement in the use of these terms is evident in the leading search engines (MEDLINE and PubMed). Nederfors *et al.* (16) noted that the database MEDLINE, under the MESH heading, refers to xerostomia as "decreased salivary flow". Likewise, when the term "hypo-salivation" is entered, the reference "see xerostomia" is made. The National Library of Medicine database (PubMed) presents the same limitation observed in MEDLINE. The definition of xerostomia in epidemiological studies was extremely diverse. There is a lack of consensus in the literature regarding the definition and diagnosis of xerostomia.

The definition of xerostomia as the sensation of dry mouth that could exist in the presence of a normal or abnormal salivary flow and rate is supported by Narhi *et al.* (29), who reported no significant differences in salivary flow rates between individuals complaining of oral dryness and controls. Furthermore, only 5.7% of a sample population of 684 individual had low salivary flow rates and xerostomia. (33) Nevertheless, a decrease in salivary flow may be considered the most common etiologic factor in xerostomia (68-70). Complementary diagnostic procedures such as salivary flow rate and oral examination have been completed in several studies even though xerostomia might not correlate with actual physical evidence of oral dryness. Additionally those objective tests which do not confirm patients' subjective complaints could potentially result in patients perceiving that their symptoms are not taken seriously (16). Therefore, the development of tests considering the patient-perceived need for xerostomia treatment is required.

The majority of epidemiological studies located in this review have been conducted in Scandinavia, par-

TABLE 2
Description of xerostomia prevalence in the general population

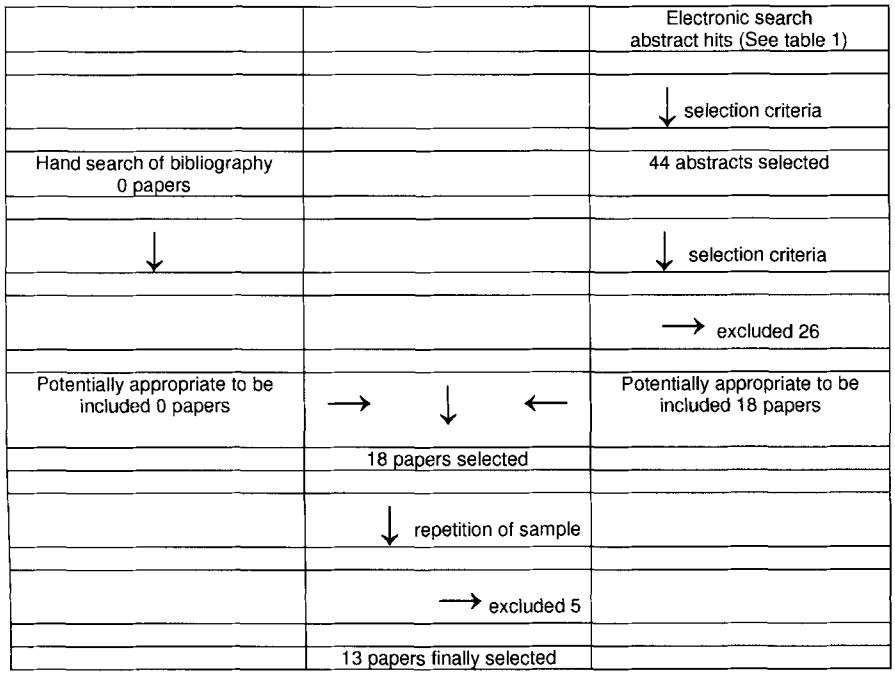
Author	Country	Total	Range	Sample Age Gender	Prevalence %	Assessment of Xerostomia: Subjective	Assessment of Xerostomia: Objective
Osterberg (26)	Sweden	968	70	Female Male	25 16	Interview. One question.	Unstimulated and stimulated whole saliva flow rate
Nederfors (30)	Sweden	3313	20-80	Female Male	28.3 23.1	Self-administered questionnaire. Does your mouth usually feel dry? and dryness related symptoms and behavior.	N/A
Jansson (36)	Sweden	1159	53-54	Female	16	Self-administered questionnaire. Different extragenital Symptoms.	N/A
Bergdahl (35)	Sweden	1427	20-69	Female Male	28.2 14.9	Self-administered questionnaire.	Unstimulated and stimulated whole saliva flow rate
Narhi (29)	Finland	341	75-85	Female Male	46* Total sample	Personal Interview. Yes or No answers to dry mouth related symptoms.	Unstimulated and stimulated whole saliva flow rate.
Anttila (21)	Finland	780	55	Female Male	33.3 25.8	Self-administered questionnaire. plus personal interview	Unstimulated and stimulated whole saliva flow rate
Reichart (34)	Germany	2023	65-74	Female Male	1.2 0.4	Personal Interview according to WHO** and ICD-DA***	N/A
Pujol (32)	Spain	268	18-over 65	Female Male	13 6.2	Telephone Interview.	N/A
Locker (28)	Canada	907	50-over 65	Female Male	20.7 13.8	Personal Interview as part of inventory in oral symptoms and complaints.	N/A
Hochberg (31)	USA	2482	65-84	Female Male	20.1 13.2	Personal Interview. Does your mouth usually feel dry? Do you wake up at night feeling so dry in your mouth that you need to drink fluid?	Unstimulated and stimulated whole saliva production by modified saxon test.
Thomson (33)	Australia	684	65-100	Female Male	24 17	Computer assisted telephone interview.	Unstimulated whole saliva flow rate
Ben-Aryeh (27)	Israel	259	over 60	Female Male	27.7* Total Sample	Self-administered questionnaire containing a short explanation of xerostomia	Unstimulated and stimulated whole saliva flow rate
Espinoza (37)	Chile	889	65-over 75	Female Male	44* total sample	Personal Interview according to WHO.	N/A

* In these studies, prevalence of xerostomia was not divided by gender.
** WHO: Recording of data based on World Health Organization.
*** ICD-DA: International Classification of Diseases in Dentistry

ticularly Sweden and Finland. Prevalence data from one country may not be characteristic of the global population since unique cultural and etiological factors may play a role. Therefore, further studies are needed based on populations other than Scandinavian.

The studies presented here show a very wide range in the prevalence of xerostomia, from 0.9% (34) to 46% (29). This variation between reports might be explained as a consequence of differences in the diagnostic process. It is interesting to note that if the study (34) with the lowest prevalence is not considered, the prevalence values are less dispersed (20-46% for females and 13-26% for males). Again, the diagnostic process may be a significant reason for this discrepancy. Being a subjective sensation, it is personal and varies depending on the individual reporting the symptom as well as manner in which the questions are worded. As suggested by Sreebny, asking "Do you suffer from dryness in the morning or evening?" yields one kind of answer and asking, "Do you suffer from continuous dryness?" produces a different one (71). Also, a "reporting behavior" or the way in which people report symptoms in general may have an impact. Underlying physical/medical conditions, medications being taken, and exposure to risk factors could also potentially affect the reported prevalence. This should not be the case in the present systematic review because these conditions were considered as exclusion criteria. Development of

FIGURE 1
Flow diagram of the literature search



uniform protocols for collecting and reporting the data would be very important in studying the worldwide prevalence of xerostomia.

All of the articles in the present review also demonstrated increasing prevalence of subjective perception of dry mouth as people age. Pujol *et al.* (32) reported a difference of more than 10 points between the 35- to 64-year-old group (7.3%) and the over-65 group (18.2%). Most of the articles evaluated the prevalence of subjective dry mouth on older populations (50 years and older). This condition is believed to be fairly common among older adults, and this may explain the large number of studies focusing on this population. On the other hand, there are very limited data on prevalence of xerostomia in children. Only 4 studies on children were identified. (72-75). As all of them only measured salivary flow rates, these results were not included in the present review. Due to the shortage of population-based studies on the prevalence of xerostomia in younger groups, comments and/or conclusions about implications of xerostomia in adolescents and children cannot be drawn from this review. The need for more population-based studies about xerostomia in younger adults and especially teenagers and children is somewhat controversial. Although there is no solid evidence of younger non-medically compromised populations being affected by xerostomia, it is important to acknowledge that most of the reported data are from individuals 50 years and older. The scarceness of reports on younger populations makes it difficult to conclude that xerostomia increases with age.

Almost all of the selected publications discriminated their sample by gender; only one study (36) involved only females. Although all the studies did not report the actual prevalence of xerostomia in males and females, those reporting showed greater rates in woman than men. Bergdahl *et al.* (35) reported a difference of 13 points between genders. On average, female patients reported an 8% higher prevalence of subjective dry mouth. Based on these reports, it is reasonable to believe that the differences in prevalence between genders are real and that women have a higher prevalence of xerostomia than men.

Conclusions

- A standardized definition and protocol to diagnose xerostomia needs to be developed to facilitate comparison between studies and communication between researchers.
- Studies evaluating younger age groups should be conducted to understand the impact throughout the lifespan.
- Most of the current literature focuses on prevalence of xerostomia in the Scandinavian population. More population-based studies in other regions are needed.

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