

## Xerostomia: an update for clinicians

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### ABSTRACT

Saliva plays an important protective role in the oral environment, and reductions in saliva quantity are known to increase the risk of oral diseases. Importantly, xerostomia or the perception of a dry mouth is now being recognized as an important risk factor for dental diseases. Furthermore, the subjective sensation of a dry mouth is a debilitating condition in itself that impacts on the quality of life of sufferers. With approximately 1 in 5 people reporting some form of dry mouth, and an increasing prevalence in the elderly, it is important for clinicians to have a thorough understanding of this problem. The aim of this paper is to review some of the literature relating to xerostomia in order to provide an evidence based update for clinicians.

**Keywords:** Xerostomia, salivary gland hypofunction, dry mouth.

**Abbreviations and acronyms:** OHRQoL = oral health-related quality of life; SGH = salivary gland hypofunction; XI = Xerostomia Inventory.

(Accepted for publication 23 August 2009.)

### INTRODUCTION

Saliva plays an important role in oral health. It functions in protection against bacteria and fungi, transportation of nutrients and digestive enzymes, lubrication of the oral cavity, remineralization of teeth, as well as aiding in chewing, swallowing and speech. There are two important conditions relating to saliva and its impact on oral health that are often confused in the literature – salivary gland hypofunction (SGH) and xerostomia, and it is important for the clinician to have a good understanding of these conditions.

Salivary gland hypofunction is a condition in which unstimulated or stimulated salivary flow is significantly reduced, and can also result in alterations of the chemical composition of saliva. It is generally defined as an unstimulated whole saliva flow rate of less than 0.1–0.2 mL/min, and a stimulated whole saliva flow rate of less than 0.7 mL/min.<sup>1–3</sup>

Xerostomia is defined as the subjective perception of dry mouth.<sup>4</sup> The perception of dry mouth is sometimes, but not necessarily accompanied by a reduction in salivary flow. Although SGH can be a major cause for deleterious effects on a patient's oral health, xerostomia can also have a major impact on a patient's oral health and quality of life. Symptoms of xerostomia include

halitosis, oral soreness and burning, difficulty swallowing and talking, and altered taste.

Xerostomia and SGH can also increase the risk of dental caries, and can contribute to periodontal diseases and oral infections such as candidiasis. Saliva has an important role in the retention of dentures, and SGH can have a significant detrimental effect on denture wearers. Finally, patients with a dry mouth often sip or suck sweet and/or acidic drinks and confectionery to relieve their symptoms and this can also increase the risk of dental caries. Since the perception of dry mouth is an increasingly common finding among patients, it is important for clinicians to have a sound understanding of this condition.

### Defining and measuring xerostomia

Much of the variability in the literature regarding xerostomia can be attributed to differing definitions of xerostomia and also different protocols for its measurement. The early literature regarding dry mouth often made no distinction between xerostomia and SGH, therefore xerostomia was often reported as a reduction in salivary flow rather than as a subjective feeling of dry mouth. Xerostomia as a subjective condition can only be assessed through direct questioning of patients.

Even with a consistent definition of xerostomia as the subjective feeling of dry mouth, there is still variability in the literature between studies that use different measures for assessing whether or not a patient is xerostomic. Considerable research has focused on how to more effectively diagnose xerostomia. Current studies use questionnaires which range from a single item up to 11 items. Single-item measures can be problematic because they limit the classification of patients as either xerostomic or non-xerostomic based on an arbitrary cut-off point, and often refer to specific situations or times when a patient might experience xerostomia. For instance, different single-item measures such as, “Does your mouth feel dry when eating a meal?” and “How often does your mouth feel dry?” will classify different people as xerostomic.<sup>5</sup> Prevalence rates within the same sample can vary depending on the question used. Ikebe *et al.* found drastically different prevalence rates when asking about dry mouth in relation to eating versus waking, with a prevalence of oral dryness during eating of 9%, but a prevalence of oral dryness upon waking of 38%.<sup>6</sup>

Fox *et al.* developed four questions to gain a more complete assessment of the perception of dry mouth.<sup>4</sup> Two of the questions refer to difficulties with swallowing (addressing behaviours related to relieving or avoiding oral dryness), with one item related to the feeling of dryness during eating, and the last item related to the amount of saliva. Nahri *et al.* expanded upon the work of Fox *et al.* by using a total of 16 questions in their population based study.<sup>7</sup> There were two questions about how behaviours aimed to reduce or avoid dry mouth, four questions addressing difficulties and impairments related to speaking, swallowing and taste, four questions about burning and itching sensations in the oral cavity, and five questions regarding dryness in other areas of the body including the lips, nose, throat, skin and eyes.

Even though additional questions increased the amount of available information, the form of the questions still limited patients’ responses to ‘yes’ and ‘no’ answers. Therefore, the multidimensional continuous scale Xerostomia Inventory (XI) was developed to address this. It contains a total of 11 items aimed to assess the broad experience of dry mouth. Using a continuous scale is advantageous because it avoids dichotomizing patients as either xerostomic or non-xerostomic by determining the severity of the condition.<sup>8</sup> The XI also allows changes in severity of the condition to be monitored over time. Each of the 11 items has five possible responses ranging from ‘hardly ever’ to ‘very often’ which are given a numerical value ranging from 1 to 5. A XI score results from the sum total of the 11 items, and a change in XI score of 6 or more has been shown to be significant, where an increasing in score correlates to a worsening condition.<sup>9</sup>

Since there are many factors that can contribute to the perception of dry mouth, it is necessary to have an instrument that addresses the direct questioning of an overall feeling of oral dryness, oral dryness during specific times of the day or in relation to certain activities, behaviours related to relieving or avoiding oral dryness, as well as feelings of dryness in other areas of the body. So far the XI is the most comprehensive measure of xerostomia and remains the only instrument that has been developed to assess a patient’s xerostomic classification on a continuous scale. It is also the only instrument that has been validated to measure changes in the severity of xerostomia over time.<sup>10</sup>

### Prevalence of xerostomia and SGH

Population based studies that report on xerostomia prevalence are limited, with the majority of research based on convenience samples of institutionalized elderly. Even so, the studies that do report the prevalence of xerostomia within general populations have shown great variability, which may be due to different definitions and instruments used to measure it. The prevalence of xerostomia in population based studies ranges from 10 to 46%, with a lower prevalence for men (9.7–25.8%) than women (10.3–33.3%) (Table 1). A recent systematic review of population based research suggests a prevalence in the community of approximately 20%, although this appears to be higher in older populations and the institutionalized.<sup>11</sup> It is generally accepted that ageing *per se* has no significant clinical impact on salivary flow rates, yet the prevalence of xerostomia appears to increase with age, mainly affecting the middle-aged and elderly populations. With an ageing population, it is becoming increasingly common to encounter cases of xerostomia.

Studies conducted on both xerostomia and SGH within the same population show that the two are in fact separate conditions (Table 2). Xerostomia prevalence ranged from 8.3 to 42%, while SGH prevalence ranged from 11.5 to 47%. Although the prevalence of xerostomia and SGH showed great variability separately, the prevalence of both conditions existing together is about 2 to 5.7%. In all studies, the prevalence of the two conditions combined was significantly lower than either xerostomia alone or SGH alone.

### Medication use

Although the role of medication, both in terms of polypharmacy and specific medications, in dry mouth and dental caries has long been assumed to be fact, the evidence is much less clear. Although increasing age has been shown to correlate with a higher prevalence of xerostomia, salivary function should not deteriorate in

**Table 1. Prevalence of xerostomia in population based studies**

Author and Year	Country	Sample Size	% Total	% Male	% Female	Age Range	%	Assessment
Osterberg <i>et al.</i> , 1984 <sup>32</sup>	Sweden	968		16	25	70		Does your mouth feel distinctly dry?
Gilbert <i>et al.</i> , 1993 <sup>19</sup>	United States	600	39			65+	39	Unspecified
Locker <i>et al.</i> , 1993 <sup>20</sup>	Canada	907	17.7	13.8	20.7	50–64	14.2	22-item interview (number of questions related to xerostomia unspecified)
						65+	22.6	
Narhi <i>et al.</i> , 1994 <sup>7</sup>	Finland	341	46			75–87	46	
Nederfors <i>et al.</i> , 1997 <sup>33</sup>	Sweden	3313	25.8	23.1	28.3	20	19.3	Does your mouth usually feel dry? Plus nine additional questions
						30	17.7	
						40	20.4	
						50	22.1	
						60	32.2	
						70	33.3	
Antilla <i>et al.</i> , 1998 <sup>34</sup>	Finland	780	30	25.8	33.3	55	30	One question (unspecified) Does your mouth usually feel dry? Do you wake at night feeling that you need to drink fluids?
Hochberg <i>et al.</i> , 1998 <sup>35</sup>	USA	2482	17.2	13.2	20.1	65–69	14.1	
						70–74	17.6	
						75–79	18.3	
						80–84	21.5	
Thomson <i>et al.</i> , 1999b <sup>36</sup>	Australia	151	20.5	24.1	17.3	65–69	20.1	How often does your mouth feel dry?
						70–79	20.1	
						80+	21.5	
Bergdahl <i>et al.</i> , 2000 <sup>21</sup>	Sweden	1427	22	14.9	28.2	20–69	22	Does your mouth usually feel dry?
Jannson <i>et al.</i> , 2003 <sup>37</sup>	Sweden	1180		16		53–54	16	
Thomson <i>et al.</i> , 2006a <sup>5</sup>	Australia	972	10	9.7	10.3	32	10	How often does your mouth feel dry?

**Table 2. Prevalence of xerostomia and salivary gland hypofunction within the same sample**

Author and Year	Population	Prevalence (%)			Xerostomia assessment	SGH assessment
		Xerostomia	SGH	Both		
Johnson <i>et al.</i> , 1984 <sup>38</sup>	Institutionalized older Swedish; <i>n</i> = 154	42	43		Unspecified	Stimulated parotid saliva
Osterberg <i>et al.</i> , 1984 <sup>32</sup>	70-year-old Swedish; <i>n</i> = 973	20	31		Does your mouth feel distinctly dry?	Sialometry on subsample ( <i>n</i> = 111)
Narhi <i>et al.</i> , 1992 <sup>39</sup>	76-, 81- and 86-year old Finns; <i>n</i> = 368	12	47		Unspecified	Unstimulated whole saliva (spit method)
Thomson <i>et al.</i> , 1999b <sup>36</sup>	South Australians aged 60+; <i>n</i> = 700	21	22	5.7	How often does your mouth feel dry?	Unstimulated whole saliva (spit method)
Hochberg <i>et al.</i> , 1998 <sup>35</sup>	Americans aged 65 to 84 years; <i>n</i> = 2520	17.2	14.8	4	Does your mouth usually feel dry? Do you wake at night feeling so dry in your mouth that you need to drink fluids?	Stimulated whole saliva
Bergdahl <i>et al.</i> , 2000 <sup>21</sup>	Swedish aged 20 to 69 years; <i>n</i> = 1427	22	11.5	2	Does your mouth usually feel dry?	Unstimulated whole saliva (spit method)
Ikebe <i>et al.</i> , 2007 <sup>6</sup>	Japanese aged 60+; <i>n</i> = 287	8.3	19	3.3	Does your mouth feel dry when eating a meal?	Stimulated whole saliva (mastication method)

healthy individuals.<sup>12</sup> Xerostomia may be the result of certain types of medications which happen to be used more in older populations. Individual use of specific types of medications is thought to contribute to an increase in xerostomia prevalence. However, this is difficult to determine because most patients use more

than one type of medication, and polypharmacy itself has been implicated in increased xerostomia prevalence.

Several drug groups have been associated with xerostomia prevalence, with antidepressants, anticholinergics and antihistamines each being shown to relate to xerostomia in multiple studies (Table 3). Since

**Table 3. Medications related to incidence of xerostomia**

Author and Year	Population	Drugs implicated
Osterberg <i>et al.</i> , 1984 <sup>32</sup>	70-year-old Swedish; n = 973	Anticholinergics Antihistamines Hypnotics Phenothiazines Sedatives
Thomson <i>et al.</i> , 2000b <sup>17</sup>	65- to 100-year old South Australians; n = 913	Anginals Antidepressants Antiasthma drugs Diuretics Thyroxine
Pajukoski <i>et al.</i> , 2001 <sup>15</sup>	Elderly Finns; n = 427	Allergy Cardiovascular drugs Hormones Psychiatric drugs Antidepressants
Rindal <i>et al.</i> , 2005 <sup>13</sup>	Americans aged 55+; n = 7720	
Thomson <i>et al.</i> , 2006a <sup>5</sup>	32-year-old New Zealanders; n = 950	Antidepressants Iron supplements Narcotic analgesics
Thomson <i>et al.</i> , 2006b <sup>17</sup>	South Australians aged 60+; n = 246	Daily aspirin Diuretics
Maupomé <i>et al.</i> , 2006 <sup>14</sup>	Americans aged 55+; n = 11 249	Cardiovascular drugs

xerostomia is thought to be a risk factor for dental caries, the strength of xerogenic medications is often tested by examining the incidence rate of dental caries and restorations. The incidence rate for restorations was approximately 40% greater for those who used antidepressants and 28% greater for those taking cardiovascular drugs compared to those who took no medications.<sup>13</sup> However, not all cardiovascular drugs have been shown to be xerogenic.<sup>14</sup> Hospitalized patients who experienced dry mouth have been shown to be taking more cardiovascular, psychiatric and allergy drugs than those who did not complain of dry mouth. However, in outpatients only hormones were significantly related to incidence of xerostomia.<sup>15</sup> Among a cohort of older South Australians, XI scores were higher for those taking anginals without a concurrent beta-blocker at five years and those who were using antidepressants, anginals, or antiasthma drugs at both baseline and five years.<sup>16</sup>

Longitudinal studies have also shown that xerostomic status is unstable. Over an 11-year period, a quarter of the cohort changed their xerostomic status measured using XI.<sup>17</sup> Between 5 and 11 years, the overall prevalence of xerostomia increased from 21.4 to 24.8%. Two-thirds of the sample were not xerostomic at either assessment, while 1 in 10 were xerostomic at both assessments, just over 1 in 7 were new cases and just over 1 in 10 were remitted cases. Only antidepressants and daily aspirin were associated with xerostomia incidence between 5 and 11 years.

Although it is commonly found that polypharmacy is linked to xerostomia, it is still unknown why the

relationship occurs. The only multivariate analysis conducted on xerostomia and medication use resulted in findings that suggest that the link between the two may be much more complicated than it initially appears.<sup>16</sup> This study, using both XI and unstimulated salivary flow rates, showed that a specific medication taken alone may not have xerogenic effects but when taken with another medication, the combination yields an increased prevalence of xerostomia. For example, when thyroxine and diuretics were taken separately at five years, there was no significant link to xerostomia. However, when these two medications were taken together, the incidence of xerostomia was higher. This shows that in addition to individual drugs having xerogenic effects, interactions between certain drugs may also contribute to the incidence of xerostomia.

The only study focused exclusively on the link between medication use and xerostomia (XI) in young adults showed that a significant portion of this population is affected by the condition. In this sample of 32-year-olds, the prevalence of xerostomia was approximately 1 in 10, with no significant gender differences.<sup>5</sup> Since there appears to be a gender difference in older populations, it is suggested that xerostomia may develop incrementally at different rates between males and females or may be caused by major life changes. Increased rates in females may be due to differences in exposure to xerogenic medications or life changes such as menopause.<sup>5</sup> For certain medications, increased length of exposure may contribute to increased xerogenic effects. For example, anginals, antidepressants, and antiasthma drugs were shown to be significantly linked to xerostomia incidence when taken for at least five years. When taken for less than five years, only anginals without beta-blockers were shown to be significantly linked to xerostomia. Antidepressants and antiasthma drugs were not found to have a significant effect on xerostomia incidence when length of exposure was less than five years.<sup>17</sup>

Although polypharmacy has been linked to increasing xerostomia in the elderly, this has not been demonstrated in younger populations.<sup>5</sup> This suggests that medications may have differing effects on patients of various age groups. This possibility has been investigated by administering identical medications to both young and old populations.<sup>18</sup> When administered an antisialogogue, older adults had a greater reduction in salivary flow and longer salivary suppression than younger adults. However, the older group experienced longer periods of xerostomia and took longer to recover from it than younger adults in four of the eight items. In contrast, other items including time to initial xerostomic complaint and level of maximum xerostomic complaint were not significantly greater among the older group. Even though older adults are actually

experiencing a larger decrease in saliva flow, they are still reporting similar levels of xerostomic complaints to younger groups.<sup>18</sup>

### **Xerostomia and oral health**

Patients with xerostomia have been shown to have significantly more carious lesions than those without xerostomia, with 70% of those who reported dry mouth having at least one carious lesion compared with only 56% in those who did not report dry mouth. There were similar findings for root caries lesions, with 54% of those with xerostomia having at least one, as opposed to only 38% of those without xerostomia.<sup>19</sup> Furthermore, among dentate subjects, those with xerostomia had more decayed crown surfaces than those without xerostomia.<sup>20</sup> The increased risk of dental caries is likely to lead to more tooth extractions, and it has been shown that the number of teeth is associated with subjective feelings of dryness. Those with xerostomia are more likely to have fewer teeth as opposed to those without it.<sup>21</sup>

Xerogenic medications are believed to be related to an increased incidence of dental caries by two pathways. These medications are thought to modify the relationship between caries and xerostomia by reducing salivary flow which lowers buffering of plaque acids. Medications also indirectly impact on dental caries by producing xerostomia which is often relieved by consuming cariogenic foods and drinks, leading to increased demineralization. Since these two pathways are happening simultaneously, demineralization occurs more rapidly than remineralization resulting in dental caries.<sup>22</sup>

There is some evidence that suggests an inverse relationship between salivary flow rates and *Candida albicans* counts in saliva, and high *C. albicans* counts in saliva are often associated with the clinical signs of candidiasis.<sup>23–25</sup> Therefore, patients with SGH are at greater risk of developing candidiasis. There is some controversy regarding the effect of xerostomia and hyposalivation on periodontal disease. It is thought that saliva does not have a direct influence on periodontal pathogens within the periodontal pocket since there is an outward flow of crevicular fluid, and so the antibacterial components of saliva do not affect the bacteria in pockets which cause periodontal disease.<sup>26,27</sup> However, it is thought that in patients with reduced salivary flow, bacterial clearance is reduced and therefore there will be greater bacterial colonization of the oral tissues.<sup>26,28</sup>

### **Oral health-related quality of life**

Purely clinical measures of oral health such as caries experience and periodontal disease do not take into

consideration the functional and psychosocial aspects of health and disease, nor do they always accurately reflect the health status, functioning and perceived needs of individuals. Oral health-related quality of life (OHRQoL) describes a model of oral health comprising components of oral pain and discomfort, oral functional limitation, oral disadvantage and self-rated oral health.<sup>29</sup>

Since many of the population based studies have focused on the prevalence of xerostomia in older populations, OHRQoL has been studied mainly in older populations. Xerostomia is related to other oral symptoms that can negatively affect OHRQoL, and patients with xerostomia are more likely to report other oral symptoms including a burning sensation in the mouth, an unpleasant taste, bad breath and painful ulcers. Denture use is also affected by xerostomia and SGH. Oral dryness is related to higher reports of pain and discomfort among denture wearers.<sup>20</sup> The physiological effects of xerostomia cause those experiencing it to change their daily behaviours, such as speaking and eating. The following factors were significantly related to dry mouth: prevented from eating foods you would like to eat, your enjoyment of food is less than it used to be, takes you longer to finish a meal than others, embarrassed by appearance or health of teeth or mouth, and avoid laughing or smiling. Xerostomia was also related to the following behaviours: avoid eating with others because of problems chewing and avoid conversation with others.<sup>20</sup>

Xerostomia has been significantly related to oral health status, oral health satisfaction, oral health change, missing teeth, general health status, and psychological stress in the elderly.<sup>30</sup> Patients with more severe xerostomia are 2.3 to 4.9 times more likely to experience negative impact on health.<sup>30</sup> Xerostomia correlates strongly with the following life impacts: sense of taste, feeling tense, difficulty relaxing, life less satisfying, totally unable to function, feeling self-conscious, having to interrupt meals, and difficulty doing usual jobs.<sup>3</sup>

There is also a strong correlation between xerostomia and OHRQoL in younger adults, with the factors that had the greatest impact being self-consciousness, embarrassment and discomfort while eating.<sup>31</sup> These factors remained correlated with xerostomia even when controlling for indicators of poor clinical health, smoking status, and personality characteristics.

### **Clinical evaluation**

It is important to include an assessment of dry mouth for all elderly patients, since they are more likely to suffer from xerostomia, in order to have a comprehensive picture of a potentially debilitating problem, and also to help prevent complications that may arise from

the condition. As a minimum, this should include questions such as:<sup>4</sup>

- (a) Does the amount of saliva in your mouth seem to be too little, too much or you do not notice it?
  - (b) Do you have any difficulty swallowing?
  - (c) Does your mouth feel dry when eating a meal?
  - (d) Do you sip liquids to aid in swallowing dry food?
- For a more comprehensive assessment, the XI can be used, and this provides an ideal instrument to track changes in the severity of symptoms over time. A comprehensive review of the medical history and medications is also important in identifying any underlying systemic problems which may impact on salivary flow. An assessment of the intraoral soft tissues for the presence of dry, atrophic or fissured mucosa can also point to problems with salivary flow. Finally, an assessment of actual saliva flow can be performed in order to assess salivary function. Although there is no general consensus on what constitutes a normal salivary flow rate, generally an unstimulated flow rate of less than 0.1 to 0.2 mL/minute and a stimulated flow rate of less than 0.7 mL/minute are considered to be abnormally low flow rates.<sup>1-3</sup>

### Clinical management

The most important step in the management of patients with xerostomia is establishing the correct diagnosis – xerostomia, SGH or both. Next, it is important to develop an appropriate preventive programme to minimize the risk of dental caries, including regular dental visits, dietary and oral hygiene assessment and advice, and appropriate use of topical fluorides. Symptomatic relief of the symptoms of a dry mouth can include sugar-free gum or mints, oral lubricants/moisturisers and regular consumption of tap water to maintain hydration. For patients with SGH, artificial saliva substitutes or the prescription of sialogogues such as pilocarpine may be indicated.

### CONCLUSIONS

Xerostomia or the perception of a dry mouth is a potentially debilitating condition that can affect as many as 1 in 5 dental patients, with an increased prevalence in women and the elderly. There is evidence that medication use, and particularly polypharmacy may increase the risk of xerostomia. Importantly, xerostomia is not always related to an actual decrease in saliva quality or quantity. However, there is evidence that patients suffering from xerostomia are at greater risk of developing dental caries. Therefore, it is important for clinicians to have a sound understanding of this condition, including diagnosis and monitoring, to ensure that they are able to adequately treat patients with xerostomia.

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