Prevalence and Assessment of Dry Mouth: A Study among Selected Group of Elderly Patients in Dar es Salaam

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Abstract

Aim: The aims of this study were to determine the prevalence of xerostomia and hyposalivation, and to assess whether subjective measures can predict clinically determined dry mouth.

Methods: This was a descriptive cross-sectional study conducted among elderly patients aged 60 years and above, attending general clinics of a referral hospital in Dar es Salaam, between January and February, 2017. A structured interview schedule developed by Fox., *et al.* 1997 was used to assess xerostomia (subjective measure), followed by a clinical examination for dry mouth (objective measure). Analysis conducted included sensitivity, specificity, positive (PPV) and negative (NPV) predictive values; and positive (LR+) and negative (LR-) Likelihood ratio of the subjective measure in predicting objective measure of oral dryness.

Results: 334 (86% response rate) elderly patients, were interviewed and clinically examined. Their age ranged from 60 to 90 years, mean 67.7 SD 6.6. The prevalence of xerostomia and clinically assessed oral dryness was 65.3% (n = 218) and 64.1% (n = 214), respectively. The sensitivity, specificity, PPV and NPV of xerostomia index was 86%, 71.7%, 84% and 74%, respectively. The xerostomia index had a LR+ = 3.1 (CI = 2.27 - 4.05) and LR- = 0.2 (CI = 0.14 - 0.28), indicating substantial usefulness in predicting clinically determined dry mouth among elderly in Tanzania.

Conclusion: The prevalence of xerostomia and clinically assessed oral dryness are high among the studied elderly patients. It is therefore recommended that assessment of dry mouth be conducted to elderly patients, especially those with systemic disease and on medication, to assist in identifying individuals requiring further investigations needed to diagnose hyposalivation for management and prevention of complications.

Keywords: Xerostomia; Hyposalivation; Dry Mouth; Elderly; Tanzania

Abbreviations

LR: Likelihood Ratio; LR-: Negative Likelihood Ratio; LR+: Positive Likelihood Ratio; NPV: Negative Predictive Values; PPV: Positive Predictive Values

Introduction

Adequate quantity and quality of saliva plays a significant role in promoting health of the soft and hard tissues in the oral cavity, as well as the individual's general health of [1]. Saliva is necessary for the integrity of the oral tissues and is critical for protection and maintaining of oral and systemic health [2-5].

Xerostomia defined as perceived feeling of dry mouth, is usually identified by responding to a set of symptom questions, while hyposalivation, is objectively determined low salivary flow [1,6]. These conditions are a significant burden to individuals especially the elderly population [7,8]. The prevalence of xerostomia can vary depending on the measure used for assessment. The reported prevalence among elderly range from 1% to over 30% in population based studies [9-11]; with slightly higher prevalence in hospital based studies [12]. Studies on hyposalivation revealed varying prevalence, of 11% in community population studies [11] to over 50% in hospital based population studies [13]. A number of factors have been reported to be linked to xerostomia and hyposalivation. An increase in prevalence of xerostomia has been observed with aging; and significantly higher prevalence was reported among females [14]. Likewise, oral and systemic diseases and conditions like oropharyngeal cancers, can contribute to dry mouth directly or as a consequence of their management [15,16].

Clinicians and researchers are interested and concerned with the ability to correctly predict the presence or absence of disease/ condition or the status of presenting symptom [17]. When assured of the diagnosis, a clinician or researcher may provide preventive and management of a disease/condition with confidence. Xerostomia can be measured using indices that report on individual's perception to oral dryness, using either single or multi-item questionnaires [8]. Multi-item questions have been reported to be superior to single item measures, since the former appear to capture more information regarding xerostomia [18-21]. Among measures that assess hyposalivation, the most advocated clinical methods are unstimulated and stimulated whole salivary flow rate [22-24]. These measures though, together with those that require equipment such as sialography or magnetic resonance scanning, are reported to be cumbersome in a routine general clinical setting [25]. Visual assessment of dry mouth is beneficial during routine dental and general elderly patient care, as well as in large community studies since they are non-invasive, and are reported to be the best way to identify localized dehydration that may occur in conjunction with normal salivary flow [25,26].

Various instruments for assessment of dry mouth are available, nonetheless, the choice depends on a number of factors, one of them being minimizing respondent burden [25]. Therefore, identifying simple, easy to administer and accurate measures is of prime importance. Studies done to assess the correlation between subjective measures (self-reported oral dryness) with objective measures (hyposalivation) report weak or no correlation [25]. These reports suggest the inclusion of measure for salivary flow rate to diagnose dry mouth [23].

Currently there is no retrievable data on prevalence and measures used to assess xerostomia and hyposalivation among Tanzanian elderly. This study therefore set out to examine: first, the prevalence of xerostomia and hyposalivation among selected group of Tanzanian elderly; secondly, the ability of xerostomia assessment, to predict clinically assessed dry mouth among the elderly patients, in Dar es Salaam, Tanzania.

Materials and Methods

This was a descriptive cross-sectional study conducted among elderly patients attending Mwananyamala referral hospital in Dar-es salaam city, from January to February 2017. An elderly was classified as a person aged 60 years and above, the pensionable age used by the government of Tanzania. Sample size for cross sectional quantitative variables of 384 elderly patients was estimated by taking into consideration: prevalence of xerostomia and hyposalivation to be 50% (there was no retrievable data on prevalence of xerostomia and hyposalivation in Tanzania), the standard error of 5% (0.05). All patients aged 60 years and above who were attended at the Mwananyamala

hospital during the study period and willing to participate, were included in the study. Elderly patients who were receiving radiotherapy in head and neck region, and those with health conditions that could interfere with interview and clinical examination, were excluded from the study.

Structured interview schedule was administered by trained and calibrated research assistants. The questionnaire, constructed in English and translated into Swahili, an official language in Tanzania, included questions on: social-demographic details (age and sex) and use of systemic medications. To assess xerostomia, ten questions on perceived symptoms of dry mouth adopted from Fox., *et al.* [18] were included in the questionnaire (Table 1). Each item in the xerostomia scale was scored 0 = no symptom, or 1 = yes has symptom. A total score was calculated which ranged from 0 to 10. For analysis, the total score was dichotomized into 0 including those who scored 0; and 1 to include score 1-10, i.e. those who perceived at least symptom.

	Symptom questions included in a questionnaire
1	Do you experience mouth dryness during the night or upon waking up?
2	Do you experience mouth dryness during the day?
3	Do you keep a glass of water next to your bed?
4	Do you drink fluids while swallowing dry foods?
5	Do you experience mouth dryness during meals?
6	Do you experience problems with swallowing foods?
7	Do you use chewing gum on a daily basis to eliminate a feeling of mouth dryness?
8	Do you use hard fruit or mint candies on a daily basis to eliminate a feeling of mouth dryness?
9	Do you perceive the volume of saliva in your mouth as too small or do you just not notice it?
10	Do you need to moisten your mouth?

Table 1: Questionnaire to assess xerostomia according to Fox., et al [18].

Psychometric analysis of the subjective measure in terms of content validity of the Swahili version of a questionnaire developed by Fox., *et al.* [18] was assessed. In the same line reliability of the inventory was examined for internal consistency to check for homogeneity of the ten items that measure xerostomia.

After completing interview of participants, intra-oral clinical examination was performed by one author (AJL) who was trained and calibrated. Assessment of dry mouth was conducted by observing whether the front part of an intraoral examination mirror sticks to the buccal mucosa (Visual Analogue Scale). A score of 0 = intraoral mirror does not stick (no oral dryness) or 1 = intraoral mirror sticks to buccal mucosa (presence of oral dryness).

Data were analyzed using the Statistical Package for Social Sciences (SPSS) for PC, version 23.0 (IBM corporation, Armonk, NY, USA). Cross tabulation using Chi-square test was used to assess bivariate relationship, with significant relationships set at $p < 0.05$. To determine whether or not xerostomia can predict clinically assessed dry mouth, McNemar's statistical test (cross tabulation) was used. The following parameters were calculated: (i) sensitivity test that is, the proportion of subjects with xerostomia who will be clinically diagnosed with oral dryness; (ii) specificity test meaning the proportion of subjects without xerostomia who will be clinically diagnosed not to have oral dryness; (iii) positive predictive value (PPV) means the proportion of elderly with xerostomia who actually have clinically determined oral dryness; (iv) negative predictive value (NPV) means the proportion of elderly without xerostomia who were actually diagnosed not to have clinically determined oral dryness. The likelihood ratio (LR) and the 95% confidence intervals were then calculated for each association, that is, the increased likelihood of having dry mouth given the presence of xerostomia.

Results

Information was obtained from 334 elderly patients aged 60 to 90 years, mean age 67.7 SD6.6, who were available during the study period. Majority of the participants were females (55.4%, n = 185), younger elderly group of 60 - 65 years (74.9%, n = 250) and those who reported to use at least one systemic medication (76.6%, n = 250).

Prevalence of xerostomia was 65.3% (n = 218). Overall, the most frequently reported oral symptom of xerostomia was 'dry mouth at night or upon waking up' (61.7%, n = 206), while the least reported symptom was the 'use of chewing gum on daily basis to eliminate feeling of dry mouth' (3.3%, n = 11). When the patients were clinically examined, 64.1% (n = 214) were observed to have dry mouth.

Table 2 shows the distribution of study participants who have xerostomia and clinically assessed oral dryness; according to their age, sex and reported use of systemic medication. Xerostomia and clinically assessed dry mouth were significantly higher among elderly aged 70 years and above compared to their younger counterpart (p-value 0.004 and 0.000, respectively). Assessment of bivariate relationship by sex showed no statistically significant difference between male and female patients for both xerostomia and mouth dryness. Table 2 also presents a higher percentage of elderly who reported to use medications of different forms were clinically observed to have dry mouth (66.8%, n = 171, p = 0.041). On the contrary, this difference was not observed among patients with xerostomia (66.8% (171), p = 0.177).

Variables		Xerostomia (N = 218)		Clinical dry mouth (N = 214)	
Socio-demographic		**Yes % (n)**	**P-value**	**Yes % (n)**	**P-value**
Age	60 - 69 years	61.2 (153)	0.004*	58.4 (146)	0.000**
	70 + years	77.4 (65)		81.0 (68)	
Sex	Female	62.7 (116)	0.163	63.8 (118)	0.497
	Male	68.5 (102)		64.4 (96)	
Use of Systemic medication: Yes		66.8 (171)	0.177	66.8 (171)	0.041*

Table 2: *Distribution of elderly patients with xerostomia and clinically assessed dry mouth according to socio-demographic characteristics and use of systemic medications (N = 334).*
* Statistically significant at p < 0.05.
** Statistically significant at p < 0.01.

None of the questions of the Kiswahili version of Fox., *et al.* [18] inventory were omitted by elderly. Internal consistency reliability analysis showed homogeneity of the ten items of the index [18]. The corrected item-total correlation between each item and total score after omitting the item ranged between Cronbach's alpha 0.199 and 0.730; and the standardized Cronbach's alpha coefficient was 0.859 (Table 3).

		Symptom items	**Corrected item-total correlation**	**Alpha if item deleted**
	1	Experience mouth dryness during the night or upon waking	.695	.850
	2	Experience mouth dryness during the day?	.729	.847
	3	Do you keep a glass of water next to your bed?	.730	.847
	4	Do you drink fluids while swallowing dry foods?	.683	.851
	5	Do you experience mouth dryness during meals?	.663	.853
	6	Do you experience problems with swallowing foods?	.555	.862
	7	Do you use chewing gum on a daily basis to eliminate a feeling of mouth dryness?	.199	.880
	8	Do you use hard fruit or mint candies on a daily basis to eliminate a feeling of mouth dryness?	.299	.877
	9	Do you perceive the volume of saliva in your mouth as too small/ excessive, or do you just not notice it?	.603	.858
	10	Do you need to moisten your mouth?	.611	.058
Standardized Cronbach's Alpha				0.859

Table 3: *Internal consistency reliability of the Kiswahili version of Fox., et al. [18] among elderly patients: Corrected item-total correlation and Cronbach's alpha if item deleted.*

Among the 218 elderly participants who reported to have xerostomia, 184 were clinically observed to have oral dryness (sensitivity = 86%). Whilst for those 116 elderly patients who did not perceive xerostomia, 86 of them were observed not to have clinically identified oral dryness (Specificity = 71.7%) (Table 4). The table 4 also shows that, there is an 84% chance (positive predictive value-PPV) that the elderly who reported to have xerostomia actually have clinically determined oral dryness. Correspondingly, there is a chance that 74% (negative predictive value-NPV) of the elderly who tested negative in xerostomia will not have oral dryness when observed clinically.

Xerostomia	Clinical dry mouth		PPV	NPV	Likelihood Ratio (95%CI)	
	Yes	No			Positive	Negative
Yes	184	34	0.84	0.74	3.1 (CI = 2.27 - 4.05)	0.2 (CI = 0.14-0.28)
No	30	86				

Table 4: *Performance of xerostomia assessment compared with the clinical examination for dry mouth. Cross tabulation (McNemar's test) N = 334.*
*PPV: Positive Predictive Value; NPV: Negative Predictive Value, LR (95%CI): Likelihood Ratio (95% confidence intervals).

In order to determine how much more (or less) likely an elderly patient with xerostomia will have clinically assessed oral dryness than patients who did not perceive xerostomia, Likelihood ratios (LR) were calculated. Table 4 shows that the elderly who perceived xerostomia are three times more likely to have a clinically determined dry mouth, than the elderly patients without xerostomia, LR+ = 3.1 (CI = 2.27 - 4.05). Also, elderly without xerostomia are 0.2 times more likely to occur in people with dry mouth compared to elderly without dry mouth, LR- = 0.2 (CI = 0.14 - 0.28).

Discussion

Prevalence of dry mouth and xerostomia were considerably high among elderly patients attending Mwanyamala Hospital, in Dar es salaam, showing increased risk of developing oral and dental complications which might interfere with their quality of life. These findings are higher than what has been reported previously in hospital based studies [12,27-29], probably due to different types of measure utilized as well as cultural differences in reporting subjective symptoms [29].

Of interest in this study, is the finding that elderly patients aged 70 years or more were more likely to have xerostomia and clinically be found with dry mouth than younger elderly. This finding is in line with what has been reported in other studies [30]. In the latter study, an increase in mouth dryness with ageing was not established among the individuals who are not on medication. This study being a hospital based; cumulative effect of pharmacological treatment and disease, could be a plausible explanation rather than ageing per se [1,30]. The latter explanation seems realistic since a statistically significant higher percentage of elderly people who used medication were clinically diagnosed to have dry mouth. Failure of sex to significantly predict presence of xerostomia and clinically determined dry mouth is in line with what has been reported by Wiener and co-workers [27]. In contrast to what was observed in this study, Guggenheimer and Moore reported that females are more affected with xerostomia and dry mouth, than males [2]. Further investigations are suggested to clarify sex differences, particularly using community-based studies.

Diagnostic tests are useful when they are able to identify a person with disease/condition or exclude those without disease/condition. Test- retest as a measure of reliability of clinical examination and interview could not be performed because oral health education and referrals were provided to participants after completion of oral examination. Face validity of the Swahili version of Fox., *et al.* [18] inventory can be considered satisfactory as none of the items were omitted. Similarly, Cronbach's alpha obtained for internal consistency of

Swahili version of Fox., *et al.* index is above the recommended value of 0.70 hence reliable for use among Tanzanian elderly [31]. The two items about use of chewing gum and use of hard fruit or mint candies on a daily basis to eliminate a feeling of mouth dryness, were the least predictive of clinically observed dry mouth, in the current study among the elderly. The study being hospital based, with participants being elderly patients, 95% reporting to have systemic diseases, could influence their choice of what to consume/eat or using food items such as candy and chewing gum might have been discouraged. Another explanation could be that the items are not culturally applicable among the Tanzanian elderly, hence may need further elucidation. Notwithstanding this, when the analysis was repeated while omitting the two symptom items with low score, no significant change in the Cronbach's alpha was observed.

The current study assessed the ability of xerostomia measure to predict the probability of diagnosing dry mouth clinically. The proportion of elderly with xerostomia and clinically diagnosed with dry mouth, was noticeably high (sensitivity = 86%). These values are higher than those reported by Wiener and co-workers [27]. Likewise, a considerably high proportion of elderly without xerostomia also had no clinically detected dry mouth (specificity = 71.7%), which is comparable to the findings of Wiener., *et al.* [27], but higher than what was reported by Hay., *et al* [25]. As depicted on table 4, the findings on PPV and NPV in this study are higher that what has been reported before [25]. The higher predictive values observed in this study could be due to the type of participants having high prevalence of both xerostomia and clinically determined dry mouth, than what has been reported among community samples previously [25]. Despite this explanation, the Likelihood ratio (LR+ and LR-) observed, which is the recommended assessment of diagnostic accuracy, reveal that xerostomia measure moderately increases the probability of clinically determined dry mouth, LR+ = 3.1 (CI = 2.27 - 4.05). Likewise, not having xerostomia substantially decreases the probability of having clinically determined dry mouth LR- = 0.2, (CI = 0.14-0.28) (Table 4). What makes the use of Likelihood Ratio favorable to clinicians is the ability to use sensitivity and specificity of a diagnostic measure to a patient, by estimating a patients' probability of having a disease [32]. Evidently, the latter is made possible after ascertaining a thorough patient history, examination and clinical expertise of a clinician.

It has been recommended that, for accurate diagnosis of patients with low salivary function, a triad of patient examination should be executed; including assessment of hyposalivation, clinical examination (visual analogue Scale - VAS) and perceived oral dryness (xerostomia). Thenceforth, in situations where patient examination for hyposalivation is not feasible, assessing xerostomia as well as a clinical check for dry mouth; in combination with a detailed history for diseases or medication and habits that have an effect on salivary gland function; might assist in identifying patients who are at risk for xerostomia and clinical dry mouth [33]. Since VAS has not been the most recommended method in determining patients with hyposalivation, its utilization together with use of questionnaire, could be a step towards identifying patients who should be further tested for hyposalivation, e.g. unstimulated or stimulated salivary flow.

Interpretation of these findings should be taken with caution, this study being a hospital based, may present prevalence data that is not representative of the Tanzanian community. Despite the lack of representativeness, hospital-based studies like this one, maybe valuable when it comes to assessing constructs of unknown prevalence in the community. Notwithstanding these limitations, these findings form a baseline information on prevalence and measures for dry mouth that have not been studied before among Tanzanians. Furthermore, the clinical assessment of dry mouth measure, used as a gold standard, in this study did not assess salivary flow (unstimulated / stimulated). Nevertheless, the current measure is simple, non-invasive and does not require special equipment, and hence suitable for use in routine patient examination as in non-dental clinics. Even though complaint of dry mouth does not necessarily reflect actual mouth dryness or hyposalivation, some single item questions have shown high predictive values of salivary function [18]. In this particular notion, multi-item scales used to assess xerostomia in this study have been seen to be superior to single-item ones, in that, in the former, more information that is perceived can be obtained.

Conclusion and Recommendations

The prevalence of xerostomia and clinically assessed oral dryness are high. The Swahili version of the Fox., *et al*. inventory has performed satisfactorily; and fair usefulness in predicting mouth dryness among elderly in Tanzania. It is therefore recommended that assessment of dry mouth be conducted to elderly patients, especially those with systemic disease and on medication, since the condition is more likely to occur. Thorough history taking, assessment of xerostomia and clinical examinations should routinely be done to assist in identifying individuals requiring further investigations using unstimulated or stimulated whole salivary flow rate. This will assist to diagnose hyposalivation for management and prevention of complications.

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Conflict of Interest

The authors declare that they have no competing interests.

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