

Association Between Xerostomia and Oral Health-Related Quality of Life in Post-Radiotherapy Patients with Head and Neck Cancer

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KEYWORDS

Xerostomia, oral health, quality of life, head and neck cancer, radiotherapy

ABSTRACT

Xerostomia (dry mouth) is a common and persistent side effect in head and neck cancer (HNC) patients following radiotherapy, often impairing oral health-related quality of life (OHRQoL). This cross-sectional study assessed xerostomia prevalence, severity, and its association with OHRQoL among 107 post-radiotherapy HNC patients at Universiti Sains Malaysia Specialist Hospital. Participants completed the Malay versions of the Summated Xerostomia Inventory [SXI(M)] and the short Oral Health Impact Profile [S-OHIP(M)]. Xerostomia was reported by 93.5% of patients, with 53.3% experiencing moderate severity (mean SXI(M) score: 10.5, SD=2.89). Oral health impact was reported by 69.2% (mean S-OHIP(M) score: 13.7, SD=9.70). A significant positive correlation ($r=0.652$, $p<0.001$) indicated that higher xerostomia severity was linked to poorer OHRQoL. Logistic regression showed that each one-point increase in the SXI(M) score raised the odds of experiencing an oral health impact by 71–79%, with crude and adjusted odds ratios of 1.71 (95% CI: 1.36–2.14) and 1.79 (95% CI: 1.41–2.27), respectively. The model achieved 81.3% classification accuracy and an ROC area of 0.840. Findings underscore the high prevalence and impact of xerostomia, emphasising the need for routine assessment and patient-centred interventions to enhance survivorship care.

INTRODUCTION

Head and neck cancer (HNC) encompasses a group of malignant tumours arising from the tissues of the larynx, nasopharynx, oral cavity, and lips [1]. It ranks as the seventh most prevalent malignancy worldwide, with squamous cell carcinoma accounting for over 90% of cases [2]. Due to its anatomical complexity and functional implications, HNC typically requires a multidisciplinary treatment approach, with radiotherapy serving as a cornerstone – either as a primary modality or in combination with surgery and chemotherapy [3].

Radiotherapy employs high-energy radiation to eradicate cancer cells or inhibit their proliferation while aiming to spare surrounding healthy tissues. However, in HNC treatment, the salivary glands –

particularly the parotid and submandibular glands – are frequently located within or adjacent to the radiation field, making them highly susceptible to damage [4]. Radiation-induced injury impairs the glands' ability to produce saliva, resulting in xerostomia, a subjective sensation of dry mouth typically associated with hyposalivation or altered salivary composition [3]. A systematic review by Jensen et al. [5] reported that nearly all HNC patients developed xerostomia during radiotherapy, with symptoms frequently persisting for months or even years after treatment, regardless of the radiotherapy technique employed.

Despite advances in precision techniques such as intensity-modulated radiotherapy, salivary gland damage remains difficult to avoid, and xerostomia continues to be a common and burdensome complication among HNC survivors [3]. Salivary gland injury is often irreversible, particularly when radiation doses exceed 30 Gy, although emerging

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therapies show promise for partial functional recovery in selected cases [3, 6]. In most patients, xerostomia persists as a long-term and typically permanent condition.

The impact of xerostomia on oral health is multifaceted and profound. The absence of saliva's protective functions, including lubrication, buffering, and antimicrobial activity, predisposes individuals to oral infections, periodontal disease, and dental caries [7]. Additionally, reduced salivary flow significantly compromises oral health-related quality of life (OHRQoL), manifesting as difficulties in speaking, swallowing, and mastication [8]. In elderly patients, xerostomia can interfere with denture retention due to the lack of salivary adhesion between the denture base and mucosa [9]. Altered taste perception is another frequent consequence, often leading to reduced appetite, weight loss, and nutritional deficiencies [10].

In routine clinical practice, the management of xerostomia primarily focuses on symptom relief and prevention of oral complications. Common approaches include the use of saliva substitutes, salivary stimulants such as sugar-free lozenges or pilocarpine, meticulous oral hygiene, topical fluoride applications, and regular dental follow-up to reduce caries risk [11, 12]. Patients are also advised to maintain adequate hydration and avoid xerogenic substances such as caffeine, alcohol, and tobacco [12]. While these measures help alleviate symptoms, they do not restore normal salivary gland function, highlighting the persistent nature of xerostomia following radiotherapy [13].

Despite its prevalence and clinical significance, xerostomia remains an underexplored aspect of HNC survivorship, particularly in relation to its specific effects on OHRQoL. To our knowledge, no study has examined this association within the Malaysian context, despite the substantial burden of HNC in the country [14] and local evidence documenting the long-term functional challenges survivors face following treatment [15, 16]. This gap highlights the need for context-specific evidence to better understand the lived experiences of Malaysian survivors. This study was therefore undertaken to determine the prevalence and severity of xerostomia and its association with OHRQoL among post-radiotherapy HNC patients in Malaysia. By addressing this gap in the local evidence base, we aim to enhance understanding of survivorship challenges faced by HNC survivors and to inform strategies for development of more responsive, patient-centred care strategies.

MATERIALS AND METHOD

This cross-sectional study was conducted at the Dental Clinic and Oncology Clinic of Universiti Sains Malaysia Specialist Hospital. The study population comprised post-radiotherapy patients with HNC. A total of 107 participants were recruited, with the sample size determined using a single proportion formula [17] based on the objective of assessing OHRQoL among post-radiotherapy HNC patients.

Inclusion criteria were patients aged 18 years and above who had completed radiotherapy for HNC. Exclusion criteria included patients unable to understand the Malay language, those who had received adjuvant chemotherapy, and individuals with uncontrolled systemic illnesses. Participants were recruited through convenience sampling, and written informed consent was obtained from all respondents. The study protocol was approved by the Universiti Sains Malaysia Human Research and Ethics Committee (USM/JEPeM/KK/23040328).

Data were collected using self-administered questionnaires capturing variables of interest, including perceived severity of xerostomia, OHRQoL, and sociodemographic characteristics (age, sex, ethnic group, marital status, and monthly household income). Income categories were classified according to Malaysia's 2023 household income classification system: Bottom 40% (B40) for income <MYR 4,851, Middle 40% (M40) for income between MYR 4,851 and MYR 10,970, and Top 20% (T20) for income >MYR 10,970 [18].

Perceived xerostomia severity was assessed using the Malay version of the Summated Xerostomia Inventory [SXI(M)], originally developed by Thomson et al. [19]. The SXI(M) comprises five items, each rated on a three-point scale: 'never' (score = 1), 'occasionally' (score = 2), and 'often' (score = 3) [20]. Total scores range from 5 to 15, with higher scores indicating greater xerostomia severity. Scores were also categorized as follows: 5 = no xerostomia, 6-8 = mild, 9-12 = moderate, and 13-15 = severe xerostomia [21]. A global question "How often does your mouth feel dry?" was included as an independent validity check, with response options: 'never', 'occasionally', 'frequently', and 'always' [19].

OHRQoL was measured using the short version of the Malaysian Oral Health Impact Profile [S-OHIP(M)], a validated 14-item instrument [22]. Each item was rated on a five-point Likert scale from 0 ('never') to 4 ('very often'), reflecting the frequency of oral health-related impacts over the

past 12 months. Total scores range from 0 to 56, with higher scores indicating poorer OHRQoL. Additionally, the proportion of respondents reporting at least one item as 'fairly often' or 'very often' was calculated to determine the prevalence of impact.

Data analysis was performed using IBM SPSS Statistics version 27.0. Descriptive statistics summarised sociodemographic characteristics and SXI(M) and S-OHIP(M) scores. Logistic regression was used to examine associations between xerostomia severity and sociodemographic variables with the prevalence of impact. A scatter plot was generated to visualise the relationship between xerostomia severity and OHRQoL scores, and Pearson's correlation coefficient was calculated to assess the strength of this association.

RESULTS

Table 1 summarises the sociodemographic characteristics of the 107 participants, all of whom completed the questionnaire. The majority were Malay (88.8%), male (67.3%), and aged between 40 and 65 years (59.8%). Most participants were married (86.9%) and belonged to the B40 income category.

Table 2 presents participants' responses to individual SXI(M) items. A large majority (93.5%) reported experiencing xerostomia symptoms, with most classified as having moderate xerostomia (53.3%), followed by those with severe symptoms, as shown in Table 3. The mean total SXI(M) score of 10.5 (SD=2.89) further supports a moderate level of xerostomia overall. In response to the global question on dry mouth frequency, 36.4% reported experiencing dry mouth occasionally, followed by 23.4% frequently, and 21.5% always. The remaining participants indicated they never experienced dry mouth.

The prevalence of oral health impact was 69.2%, with a mean S-OHIP(M) score of 13.7 (SD=9.70). Table 4 details the prevalence and severity scores for each S-OHIP(M) item. The most frequently reported impact was functional limitation due to chewing difficulty (35.5%), followed by avoidance of certain foods (30.8%), discomfort during eating (27.1%), and food getting stuck in the mouth (25.2%). In terms of severity, chewing difficulty had the highest mean score [1.8 (SD=1.55)], followed by discomfort during eating [1.7 (SD=1.49)], avoidance of certain foods [1.5 (SD=1.66)], and food getting stuck [1.5 (SD=1.38)].

Table 1 Sociodemographic characteristics of participants

Variable	Frequency (%)
Age group (years)	
18-39	15 (14.0)
40-65	64 (59.8)
>65	28 (26.2)
Sex	
Male	72 (67.3)
Female	35 (32.7)
Ethnic group	
Malay	95 (88.8)
Chinese	7 (6.5)
Indian	0 (0.0)
Others	5 (4.7)
Marital status	
Single	14 (13.1)
Married	93 (86.9)
Widowed/Divorced	0 (0.0)
Monthly household income (MYR)	
B40 (<4,851)	91 (85.0)
M40 (4,851-10,970)	11 (10.3)
T20 (>10,970)	5 (4.7)

Table 2 Responses of participants to each SXI(M) item

SXI(M) items	Frequency (%)		
	Never	Occasionally	Often
My mouth feels dry	26 (24.3)	41 (38.3)	40 (37.4)
I have difficulty in eating dry foods	23 (21.5)	35 (32.7)	49 (45.8)
My mouth feels dry when eating a meal	39 (36.4)	28 (26.2)	40 (37.4)
I have difficulties swallowing certain foods	38 (35.5)	22 (20.6)	47 (43.9)
My lips feel dry	33 (30.8)	38 (35.5)	36 (33.7)

Table 3 Xerostomia status of participants

Xerostomia status	Frequency (%)
No xerostomia (score 5)	7 (6.5)
Mild xerostomia (score 6-8)	17 (15.9)
Moderate xerostomia (score 9-12)	57 (53.3)
Severe xerostomia (score 13-15)	26 (24.3)

Table 5 presents the results of the logistic regression analyses examining factors associated with oral health impact. In the univariable analysis, each one-point increase in SXI(M) score was associated with a 71% increase in the odds of reporting oral health impact (OR=1.71, 95% CI: 1.36–2.14, p<0.001), indicating a significant association between xerostomia severity and likelihood of experiencing oral health-related impacts.

Table 4 Prevalence and severity of oral impact

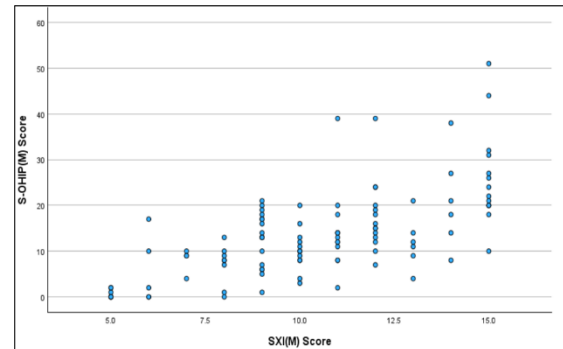
S-OHIP(M) domain and item	Prevalence of impact (%)	Mean S-OHIP(M) score (SD)
Functional limitation		2.9 (2.27)
Difficulty chewing any foods	38 (35.5)	1.8 (1.55)
Problems caused bad breath	18 (16.8)	1.2 (1.25)
Physical Pain		2.7 (2.29)
Discomfort eating any food	29 (27.1)	1.7 (1.49)
Ulcers in mouth	16 (15.0)	1.1 (1.33)
Psychological Discomfort		2.4 (1.98)
Discomfort due to food getting stuck	27 (25.2)	1.5 (1.38)
Felt shy	14 (13.1)	0.9 (1.33)
Physical disability		2.1 (2.30)
Avoided eating certain foods	33 (30.8)	1.5 (1.66)
Avoided smiling	12 (11.2)	0.6 (1.13)
Psychological Disability		1.6 (2.14)
Sleep been disturbed	13 (12.1)	0.7 (1.19)
Concentration been disturbed	15 (14.0)	0.9 (1.25)
Social disability		0.7 (1.43)
Avoided going out	6 (5.6)	0.4 (0.95)
Problems in carrying out daily activities	2 (1.9)	0.3 (0.68)
Handicap		1.2 (1.60)
Had to spend a lot of money	6 (5.6)	0.7 (1.00)
Felt less confident	7 (6.5)	0.6 (0.99)

In the multivariable analysis, SXI(M) score remained a significant predictor (OR=1.79, 95% CI: 1.41–2.27, $p<0.001$). Ethnic group also showed a significant association: Malay participants had lower odds of reporting oral health impact compared to non-Malay participants (OR=0.16, 95% CI: 0.03–0.80, $p=0.002$). However, the wide confidence interval suggests uncertainty in the estimate, likely due to the small proportion of non-Malay participants (11.2%), and the result should be interpreted with caution.

No significant two-way interactions were observed, and multicollinearity was not detected. Outlier analysis indicated that none of the data points were influential. The Hosmer-Lemeshow test ($p=0.079$) suggested good model fit. The model correctly classified 81.3% of cases, and the area under the receiver operating characteristic (ROC) curve was 0.840, indicating good predictive performance.

A scatter plot (Figure 1) demonstrated a linear relationship between SXI(M) and S-OHIP(M) scores, supporting the use of Pearson's correlation. The

analysis revealed a moderate, statistically significant positive correlation ($r=0.652$, $p<0.001$), indicating that participants with more severe xerostomia symptoms were more likely to report greater oral health-related impacts and poorer OHRQoL.

**Figure 1** Scatter plot showing the correlation between SXI(M) and S-OHIP(M) scores

DISCUSSION

Our study identified a high proportion of xerostomia (93.5%) among individuals with HNC who had undergone radiotherapy. This finding aligns with previous studies across diverse settings. Dirix et al. [23] reported a similar proportion (93%) among 75 HNC patients in Belgium, with 65% experiencing moderate to severe xerostomia—closely matching our severity distribution. In Brazil, Nascimento et al. [8] found that 97.5% of 40 HNC survivors assessed 7 to 18 months post-radiotherapy had reduced salivary flow rates (≤ 0.25 ml/min), indicating persistent glandular dysfunction. Likewise, Abou-Bakr et al. [24] reported xerostomia in 78% of 260 HNC patients one year after receiving intensity-modulated radiation therapy in Egypt, underscoring its long-term impact even with highly precise advanced radiation techniques.

The prevalence of oral health impact was notably high (69.2%) among our respondents, with a mean severity score of 13.7 (SD=9.70), indicating a substantial burden of xerostomia-related complications. Comparable findings were reported by Nascimento et al. [8], where HNC survivors had a median OHIP-14 score of 11 (range: 0–37), with most exceeding this median, suggesting a pronounced negative impact on quality of life.

Functional limitation, physical pain, psychological discomfort, and physical disability emerged as the most affected OHRQoL domains in our study, with mean severity scores of 2.9 (SD=2.27), 2.7 (SD=2.29), 2.4 (SD=1.98), and 2.1 (SD=2.30),

respectively. These results are consistent with Nascimento et al. [8], who also identified functional limitation, physical pain, and physical disability as key impacted domains. This pattern reflects the

multifaceted role of saliva in maintaining oral function, comfort, and nutritional adequacy [7, 10].

Table 5 Factors associated with OHRQoL of participants

Variable	Simple Logistic Regression			Multiple Logistic Regression		
	Crude OR (95% CI)	χ^2 statistics (df) ^a	<i>p</i> - value ^a	Adjusted OR (95% CI)	χ^2 statistics (df) ^a	<i>p</i> - value ^a
Age group (years)		1.66 (2)	0.437			
>65	1.83 (0.45–7.45)	0.72 (1) ^b	0.397 ^b			
40-65	0.96 (0.29–3.14)	0.01 (1) ^b	0.939 ^b			
18-39	1.00	–	–			
Sex						
Female	0.79 (0.33–1.87)	0.29 (1)	0.592			
Male	1.00	–	–			
Ethnic group						
Malay	0.40 (0.12–1.34)	2.17 (2)	0.141	0.16 (0.03–0.80)	5.27 (1)	0.022
Others	1.00	–	–			
Marital status						
Single	1.29 (0.40–4.20)	0.18 (1)	0.675			
Married	1.00	–	–			
Monthly household income (MYR)		3.76 (2)	0.153			
T20 (>10,970)	2.07 (0.22–19.29)	0.41 (1) ^b	0.524 ^b			
M40 (4,851-10,970)	5.17 (0.63–42.23)	2.35 (1) ^b	0.125 ^b			
B40 (<4,851)	1.00	–	–			
SXI(M) score	1.71 (1.36–2.14)	34.32 (1)	<0.001	1.79 (1.41–2.27)	37.42 (1)	<0.001

^a Likelihood Ratio (LR) test

^b Wald test

Despite the overall burden, individual S-OHIP(M) item scores were relatively low (0.3 to 1.8), suggesting that oral health problems may not have been perceived as severely disruptive. This could reflect patient adaptation to chronic symptoms or normalisation of their impact over time. Such interpretation aligns with findings from Malaysia's national oral health survey [25], which revealed a discrepancy between perceived and normative needs: while 95.2% of adults rated their oral health as reasonably good and 69.9% expressed satisfaction, 98.3% were found to require some form of oral healthcare. This incongruity underscores the subjective nature of self-assessed oral health and the risk of underreporting, with implications for healthcare planning and patient education.

Radiation-induced xerostomia is widely recognized as a significant contributor to impaired OHRQoL in HNC patients. Jellema et al. [26] demonstrated a strong association between xerostomia and reduced quality of life following primary

radiotherapy, with persistent symptoms leading to long-term disruption in daily functioning. Similarly, Pow et al. [27] found that reduced stimulated salivary flow was correlated with poorer OHRQoL. In our study, xerostomia severity measured by SXI(M) was significantly associated with increased odds of experiencing oral health impacts. Both univariable and multivariable logistic regression analyses confirmed this relationship, with each one-point increase in SXI(M) score corresponding to a 71–79% increase in the odds of reporting oral health impact. A moderate positive correlation ($r=0.652$) between SXI(M) and S-OHIP(M) scores further supports this linear relationship. These findings are consistent with Nascimento et al. [8], who reported a Pearson correlation coefficient of 0.5421 between xerostomia severity and reduced quality of life. Memtsa et al. [28] also found that salivary flow reduction is closely correlated with symptom severity and functional decline in Greek HNC patients undergoing conventional radiotherapy. Collectively, these studies reinforce the robust association between xerostomia and

compromised OHRQoL and highlight the importance of routine assessment and targeted interventions.

Building on this association, the descriptive patterns observed in individual S-OHIP(M) items offer practical direction for patient-centred care. The most frequently reported impacts including chewing difficulty, avoidance of certain foods, discomfort during eating, and food getting stuck indicate that many patients experience functional challenges during oral intake. These findings highlight the value of early referral to speech and swallowing therapists, personalised dietary counselling, and structured oral-moisturising regimens to support eating and speaking. The presence of discomfort during eating also underscores the need for proactive dental care, including fluoride applications, caries prevention, and management of mucosal irritation. Psychological discomfort related to eating difficulties may be addressed through counselling, patient education, and peer-support initiatives. Incorporating brief symptom-screening tools such as the SXI(M) into routine follow-up can help clinicians identify patients with worsening symptoms and tailor interventions accordingly. Embedding these needs into survivorship care plans aligns with patient-centred care principles and ensures that management reflects the lived experiences of HNC survivors.

Ethnic group also emerged as a significant factor predicting OHRQoL in HNC patients alongside xerostomia severity, with Malay participants showing lower odds of reporting oral health impact compared to non-Malay participants. However, this finding should be interpreted cautiously given the small proportion of non-Malay participants (11.2%) and the wide confidence interval (OR=0.16, 95% CI: 0.03–0.80). The imbalance in ethnic representation limits generalisability and highlights the need for further investigation in more diverse cohorts. Nevertheless, the logistic regression model demonstrated good fit and predictive performance, with an overall classification accuracy of 81.3% and an area under the ROC curve of 0.840. These metrics suggest the model's utility in identifying

patients at risk of oral health impact, and support the potential role of the S-OHIP(M) and SXI(M) as practical tools for clinical screening and decision-making [29].

Despite its strengths, the study has several limitations. The use of convenience sampling may introduce selection bias, and the cross-sectional design limits the ability to draw causal inference. The absence of objective salivary flow measurements also restricts the precision of xerostomia assessment, as reliance solely on self-reported measures may be influenced by recall bias and social desirability effects. In addition, the study did not include clinical variables known to influence xerostomia severity, which may have constrained the depth of interpretation. Future research should adopt longitudinal designs, incorporate objective salivary flow assessments, and include relevant clinical indicators alongside psychosocial and behavioural factors to better understand determinants of OHRQoL.

CONCLUSION

Xerostomia remains a prevalent and impactful consequence of radiotherapy in HNC patients, with clear associations to diminished OHRQoL. These findings underscore the importance of routine xerostomia screening and personalised, patient-centred management strategies, including dietary counselling, speech and swallowing therapy, proactive dental care, and structured oral-moisturising regimens to support long-term functional and quality-of-life outcomes.

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DECLARATION OF INTEREST

Authors declare no conflict of interest.

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