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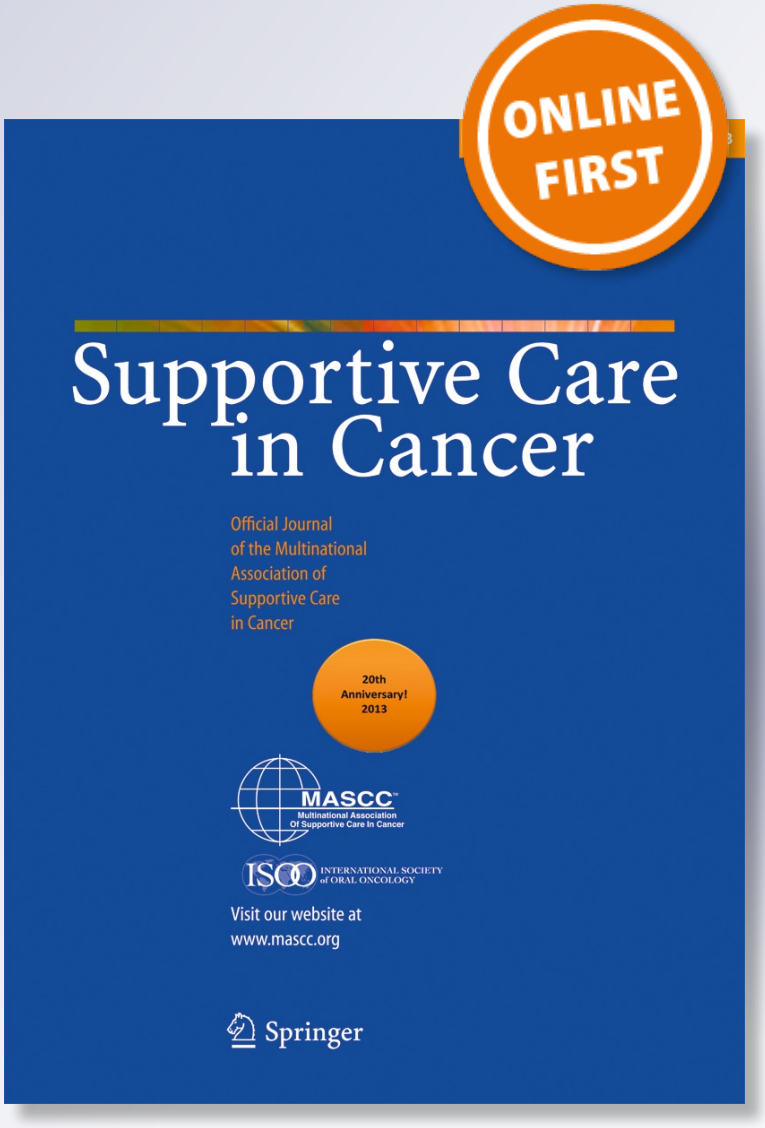

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ORIGINAL ARTICLE

Oral health conditions affect functional and social activities of terminally ill cancer patients

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Abstract
Purpose Oral conditions are established complications in terminally ill cancer patients. Yet despite significant morbidity, the characteristics and impact of oral conditions in these patients are poorly documented. The study objective was to characterize oral conditions in terminally ill cancer patients to determine the presence, severity, and the functional and social impact of these oral conditions.
Methods This was an observational clinical study including terminally ill cancer patients (2.5–3-week life expectancy). Data were obtained via the Oral Problems Scale (OPS) that measures the presence of subjective xerostomia, orofacial pain, taste change, and the functional/social impact of oral conditions and a demographic questionnaire. A standardized oral examination was used to assess objective salivary hypofunction, fungal infection, mucosal erythema, and ulceration. Regression analysis and *t* test investigated the associations between measures.
Results Of 104 participants, most were ≥50 years of age, female, and high-school educated; 45 % were African American, 43 % Caucasian, and 37 % married. Oral conditions frequencies were: salivary hypofunction (98 %), mucosal erythema (50 %), ulceration (20 %), fungal infection (36 %), and other oral problems (46 %). Xerostomia, taste change, and orofacial pain all had significant functional impact; $p<.001$, $p=.042$ and $p<.001$, respectively. Orofacial pain also had a significant social impact ($p<.001$). Patients with oral ulcerations had significantly more orofacial pain with a social impact than patients without ulcers ($p=.003$). Erythema was significantly associated with fungal infection and with mucosal ulceration ($p<.001$).
Conclusions Oral conditions significantly affect functional and social activities in terminally ill cancer patients. Identification and management of oral conditions in these patients should therefore be an important clinical consideration.

Keywords Terminally ill · Cancer · Mouth diseases · Pain · Functional and social impact · Hospice · Palliative care

Introduction

Terminally ill cancer patients suffer with progressive advanced disease that affects quality of life (QOL). Oral health plays an essential role in QOL because oral conditions contribute to symptoms that affect oral and oropharyngeal function as well as social interaction and may impact the management of medical problems [20, 22, 34]. However, the extent of oral care needed among terminally ill patients who are receiving hospice or palliative care is frequently underestimated because patients may not complain of what they believe to be inevitable discomfort in their mouths, or they may be physically or cognitively unable to do so. Under-reporting may contribute to failure by some health-care givers, health-care providers, and hospice administrators to fully appreciate the problems [16].

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Oral conditions such as salivary hypofunction, fungal and viral infections, erythema, ulceration, and dental disease can contribute to orofacial pain, denture instability, dysphagia, esthetic loss, taste disturbances, compromised oral intake, and speech [1, 3, 4, 7, 13, 17, 19, 33]. These problems can lead to unnecessary pain and may compromise QOL [38]. The clinical significance of compromised oral health in patients with terminal cancer is illustrated by the finding that xerostomia is ranked as the third-most distressing symptom after lack of energy and pain [10]. The dry oral environment caused by salivary hypofunction may contribute to mucositis, tissue irritation and ulceration, and dental caries, and increase the risk of candidiasis, which has prevalence as high as 30 % in palliative care patients [3, 7–9].

Despite the significant morbidity caused by oral conditions, the impact of oral complaints for terminally ill cancer patients is not well-documented and few studies have characterized the presence, severity, and functional/social impact of oral conditions in terminally ill cancer patients undergoing hospice or palliative care [1, 16, 18, 28, 33]. We conducted a prospective study to characterize oral conditions in terminally ill cancer patients undergoing hospice or palliative care to determine the presence, severity, and the functional/social impact of the oral conditions, all of which affect QOL. We present quantitative results after standardized oral examination by a dental health professional and from subjective patient self-report.

Patients and methods

Study design/setting

This was a cross-sectional, observational clinical study conducted in the homes of patients in collaboration with the Horizon Hospice and Palliative Care and Rainbow Hospice and Palliative Care programs. The Institutional Review Board at the University of Illinois at Chicago approved the study.

Patients

One-hundred and four terminally ill cancer patients receiving home-care level hospice or palliative care service were enrolled. Patients had a life expectancy of 2.5–3 weeks at the time of study enrollment based on a palliative performance scale score of ≥30 [2, 37]. Eligible patients were ≥18 years of age, with a primary caregiver who cared for the patient at least 5 days/week for 6 h/day and was ≥18 years of age. All participating patients completed the informed consent. Patients were seen for one visit in their homes by an oral medicine professional and a research assistant.

Study measures

Study measures included patient self-report tools and a standardized oral examination. Patient demographic data were obtained via questionnaire.

The Oral Problems Scale (OPS) was used to determine the presence of subjective xerostomia, taste change, orofacial pain, and the functional/social impact of oral conditions. The OPS is composed of 20 questions, 16 of which have a 0–4 Likert-type response format, where 0 represents "never" and 4 represents "always," and 4 of which are 11-point scales that range from 0 to 10. Most of the OPS items were adapted from other valid and reliable measures as indicated in the following list:

- *Xerostomia* was assessed using three Likert-type questions modified from previous studies of xerostomia that relate to salivary output [14, 15, 23, 26, 29]. Also, one question was adapted from the Brief Pain Inventory (BPI) [5] to measure the patient's assessment of xerostomia on an 11-point scale with 0 representing "no dry mouth" and 10 representing "dry mouth as much as can be."
- *Orofacial pain* was assessed with four Likert-type questions modified from the physical pain subscale of the Oral Health Impact Profile (OHIP) [21, 30] and the mouth and face pain subscale of the Oral Symptom and Function Scale [12]. Also, the severity of orofacial pain was rated with an 11-point scale with 0 indicating "no pain" and 10 indicating "pain as bad as it can be."
- *Taste change* was assessed with one Likert-type question from the mouth function subscale of the Oral Symptom and Function Scale [12].
- *Impact on functions* related to xerostomia and orofacial pain was evaluated with four Likert-type questions from the mouth function subscale of the Oral Symptom and Function Scale [12] along with two 11-point scales adapted from the BPI [5] assessing the severity of the functional impact of xerostomia and orofacial pain, respectively. For the functional impact items, the impact on daily life was measured with 0 representing "no interference" and 10 corresponding to "completely interferes".
- *Social impact* of xerostomia and orofacial pain was evaluated with two Likert-type questions about psychological discomfort modified from the psychological discomfort subscale of the OHIP [21, 30] and two Likert-type questions assessing the social and global impact of oral conditions from the handicap subscale of the OHIP [21, 30].

A *standardized oral examination* was used to assess perioral and oral tissues for the objective presence of salivary hypofunction, fungal infection, erythema, and ulceration/pseudomembrane formation. Clinical correlates of salivary hypofunction included lip dryness, buccal mucosa dryness, and the absence of a salivary pool on the floor of the mouth,

adapted from Navazesh and colleagues [24]. Lip dryness was measured by a 4-point scale, with 0 indicating "normal condition," 1 indicating "dry vermillion border," 2 indicating "dry, chapped and/or fissured tissue," and 3 indicating "angular cheilitis, redness or fissuring at the commissure." Similarly, buccal mucosa dryness was measured by a 4-point scale and was assessed using a dry tongue blade, with 0 indicating "normal condition," 1 indicating "looks dry, but tissue does not stick to tongue blade," 2 indicating "looks dry, and tissue sticks to tongue blade," and 4 indicating "looks dry, tissue sticks to the tongue blade, and the location of one or both parotid ducts is not apparent" [24]. A binary variable was used to indicate the presence/absence of salivary pool. Fungal infection was defined by the clinical presentation of pseudomembraneous, erythematous, hyperplastic, and/or chronic fungal infection and was confirmed by fungal culture, quantifying the presence of moderate/heavy fungal colony-forming units on selective medium. Evaluation of erythema and ulceration/pseudomembrane formation was adapted from the Oral Mucositis Assessment Scale, developed for patients who developed oral complications of cancer therapy [32]. Binary variables were used to indicate the presence/absence of fungal infection, erythema, and ulceration.

Statistical analysis

Data were entered into excel spreadsheets by two independent persons and then imported into statistical software R for analysis [35]. Statistical analysis revealed that 65 entries were missing, constituting 2 % of the OPS and oral examination data used in the analysis. Out of these missing entries, at least 46 were missing at random (new questions added after the first six subjects; researchers conducting the examination missed the entries). The remaining missing entries showed no apparent pattern. These entries constituted less than 1 % of the data and the impact of any potential nonrandom absence on our analysis based on multiple imputations was considered negligible [6].

After data cleaning, the psychometric properties of the measures were assessed and descriptive statistics [mean, standard deviation (SD), frequencies, and percentages] were computed to document the occurrence of oral conditions. The summary scores of the five subscales of the OPS were computed by rescaling each component score to a range of 0 to 10, summing the component scores and then normalizing the sums that ranged from 0 to 10. The summary for salivary hypofunction was obtained by adding the scores for salivary pool, lip dryness, and buccal mucosa dryness. Regression analysis and t test were used to investigate the associations between oral conditions and functional/social impact.

Results

Patient demographics are shown in Table 1. The 104 patients ranged in age from 29 to 112 years (mean age 66 years, SD 16.3 years). Most patients (83 %) were 50 years of age or older, female (59 %), and high-school educated or higher (83 %). Predominately, the patients were African American (45 %) or Caucasian (43 %) and married (37 %).

The frequencies of observed oral conditions are shown in Table 1. Nearly all patients (98 %) presented with salivary hypofunction with over 60 % of patients having moderate to severe salivary hypofunction. Clinical examination revealed

Table 1 Frequency of patient demographics and oral conditions

Demographics	Patients $N=104$ n (%)	Oral condition and severity	Patients $N=104$ n (%)
Age group		Salivary hypofunction[a]	
29–49	16 (15)	None	2 (2)
50–64	30 (29)	Mild	38 (37)
65–74	24 (23)	Moderate	42 (40)
75–84	17 (16)	Severe	22 (21)
85–112	15 (14)	Fungal infection	
Unknown	2 (2)	Present	37 (36)
Gender		Absent	67 (64)
Male	42 (40)	Erythema	
Female	61 (59)	Present	52 (50)
Unknown	1 (1)	Absent	52 (50)
Race/ethnicity		Ulceration	
Native American	1 (1.0)	Present	21 (20)
Asian/Pacific islander	2 (2.0)	Absent	83 (80)
African American	47 (45)	Other	
Caucasian	45 (43)	Present	48 (46)
Hispanic	5 (5)	Absent	56 (54)
Other	2 (2)		
Unknown	2 (2)		
Education			
Grades 1–11	18 (17)		
High school/GED	32 (31)		
Some college	31 (30)		
Bachelor's degree	9 (9)		
Advanced degree	14 (13)		
Marital status			
Married	38 (37)		
Live with partner	5 (5)		
Widowed	32 (31)		
Divorced or separated	11 (11)		
Never married	17 (16)		
Unknown	1 (1)		

[a] None (score of 0); mild (score >0 to 3); moderate (score >3 to 6); severe (score >6)

erythema in half of all patients (50 %), ulceration in 20 % of patients, fungal infection in 36 % of patients, and other oral conditions in almost half of the patients (46 %), such as pallor of intraoral tissues, mucosal atrophy, fissured tongue, or coated tongue.

The prevalence and mean patient scores for the OPS and standardized oral examination are shown in Tables 2 and 3. Nearly all patients (98 %) presented with clinical indicators of salivary hypofunction, with over half of these patients being categorized as having moderate to severe hyposalivation. Subjective reports of xerostomia illustrated that this complaint occurred frequently (5.8±2.5 on 0 to 10 scale) and with moderate severity (5.0±3.1 on 0-to-10 scale) (Table 2). The subjective components of the OPS (xerostomia, orofacial pain, taste change, and functional/social impact) and the objective oral examination (salivary hypofunction) were organized into subscales. The subscales were tested for internal consistency using descriptive statistics, including Cronbach's alpha, which provides a measure of internal consistency for subscales consisting of more than one item. We observed that all subscales, with the exception of taste change that consists of only one item, had an alpha of at least 0.70, indicating acceptable reliability (Table 2).

Table 3 Summary of patient scores for *Oral Problems Scale* and oral examination subscales[a]

Scale	Subscale	Mean score	SD	Median
Oral Problems Scale	Xerostomia	5.84	2.49	6.06
	Orofacial pain	1.75	2.12	1.00
	Taste change	4.45	3.60	5.00
	Functional impact	2.79	2.18	2.50
	Social impact	2.03	2.25	1.59
Oral examination[a]	Salivary hypofunction	4.48	2.12	4.29

[a] Subscale scores rescaled and normalized to range from 0 to 10

[b] Binary coding used for other oral examination items

To determine whether ulceration affected other oral conditions and/or had a functional/social impact, we stratified patients by the presence/absence of ulceration and analyzed OPS scores. Patients with ulcers had higher mean scores on all five OPS subscales than those without ulcers (Table 4). However,

Table 2 Summary of patient scores for the items of Oral Problems Scale and oral examination subscale

Scale	Subscale	Components of scale (0–4 unless indicated otherwise)	Prevalence[a] (%)	Mean score	SD	Cronbach's alpha
Oral Problems Scale	Xerostomia	Thirst frequency	94	2.39	1.14	0.86
		Dry lips frequency	92	2.53	1.20	
		Dry mouth frequency	91	2.41	1.17	
		Average severity of dryness (0–10)	91	5.02	3.07	
	Orofacial pain	Facial pain frequency	23	0.51	1.06	0.84
		Intraoral pain frequency	52	1.11	1.27	
		Frequency of mouth sores	34	0.69	1.13	
		Sharp or shooting facial/intraoral pain frequency	19	0.38	0.92	
		Average pain severity (0–10)	48	2.01	2.57	
	Taste change	Frequency of taste change when not eating	71	1.78	1.44	N/A
	Functional impact	Frequency of swallowing difficulty	61	1.28	1.22	0.80
		Frequency of speaking difficulty	57	1.13	1.22	
		Frequency of eating difficulty	55	1.25	1.38	
		Frequency of food restriction	50	1.06	1.26	
		From dryness (0–10)	66	3.10	3.07	
		From pain (0–10)	44	1.89	2.81	
	Social impact	Worried frequency	51	1.11	1.28	0.81
		Bothered frequency	51	0.95	1.10	
		Frequency of not wanting people around you	22	0.43	0.93	
		Life less satisfying frequency	36	0.76	1.22	
Oral examination[b]	Salivary hypofunction	Absence of salivary pool (0–1)	44	0.44	0.50	0.70
		Lip dryness severity (0–3)	96	1.41	0.67	
		Buccal mucosa dryness severity (0–3)	87	1.29	0.71	

N/A not applicable

[a] Score>0

[b] Binary coding used for other oral examination items

Table 4 Association of ulceration with subjective xerostomia, taste change, orofacial pain, and functional/social impact

Oral complaint or functional/social impact	Oral Problems Scale score		*p* Value
	With ulceration *N*=21	Without ulceration *N*=83	
Xerostomia	6.00±2.37	5.80±2.53	.738
Taste change	5.36±3.38	4.22±3.64	.197
Orofacial pain	2.97±2.57	1.44±1.89	.003
Functional impact	3.40±1.89	2.64±2.24	.157
Social impact	2.91±2.76	1.81±2.07	.048

Mean ± standard deviation shown

only score differences in orofacial pain and social impact were statistically significant ($p=.003$ and $p=.048$, respectively). The mean OPS score for patients with ulceration was twice that of the mean OPS for patients without ulcers ($p=.003$).

To assess the functional and social impact of subjective oral problems, we performed linear regressions using the scores for xerostomia, taste change, and orofacial pain. Xerostomia, taste change, and orofacial pain had significant functional impact on patient activities: $p<.001$, $<.042$ and $p<.001$, respectively. However, only orofacial pain had a significant association with social impact ($p<.001$) (Table 5).

Finally, we determined whether salivary hypofunction was associated with the subjective patient assessments of xerostomia, taste change, and orofacial pain from the OPS. Salivary hypofunction was significantly associated with xerostomia ($p<.001$), but salivary hypofunction was not significantly associated with taste change or orofacial pain. There was a significant association between salivary hypofunction and functional impact ($p<.001$) and an association between salivary hypofunction and social impact ($p<.028$) (Table 5).

Table 5 Association of salivary hypofunction with Oral Problems Scale components and association of functional and social impact with subjective xerostomia, taste change, and orofacial pain

	Estimate	Standard error	*t* Value	*p* Value
Salivary hypofunction				
Xerostomia	0.46	0.11	4.26	<.001
Taste change	0.15	0.17	0.88	.38
Orofacial pain	0.08	0.10	0.84	.41
Functional impact	0.39	0.10	4.10	<.001
Social impact	0.23	0.10	2.22	.03
Functional impact				
Xerostomia	0.32	0.07	4.81	<.001
Taste change	0.10	0.05	2.06	.04
Orofacial pain	0.49	0.08	6.55	<.001
Social impact				
Xerostomia	0.06	0.08	0.74	.46
Taste change	0.07	0.06	1.35	.18
Orofacial pain	0.60	0.09	6.73	<.001

Fungal infection may correlate with erythematous oral tissues in close proximity to the infection. Similarly, ulcerated tissues in various phases of development or healing may be associated with tissue erythema. We found that erythema was significantly associated (both statistically and clinically) with fungal infection ($p<.001$) and ulceration ($p<.001$). The association between fungal infection and ulceration showed a trend towards statistical significance ($p<.08$) (Table 6). We found no significant association between fungal infection and ulceration in the presence or absence of erythema (data not shown).

Discussion

The evaluation of oral conditions in terminally ill patients is not routine in hospice and palliative care, despite the potential negative impact of these conditions on function and social interaction that affect QOL. In our study, we identified oral conditions affecting a group of patients undergoing palliative or hospice care and showed that specific oral conditions in these terminally ill cancer patients have a significant impact upon oral function and social interaction.

Our finding of the high prevalence of moderate to severe salivary hypofunction is not surprising, as hydration status and medications utilized for comfort care including opioids contribute to salivary hypofunction [29, 31, 36]. We also found that salivary hypofunction significantly affected oral function and social interaction. Further, subjective reports of xerostomia indicate that this complaint occurred frequently and with moderate severity. Xerostomia has previously been identified as a major distressing symptom in terminally ill patients and a significant ongoing problem in palliative care patients [1, 16, 18, 28, 33]. Gordon et al. reported that almost two thirds of patients (62 %) experienced dry mouth in a series of 31 hospice patients receiving palliative care for terminal cancer [16]. Aldred et al. studied 20 terminally ill hospice patients and over half of the patients (58 %) reported oral dryness [1]. Jobbins et al. identified over three quarters of patients in their large series of 197 terminally ill cancer patients with xerostomia (77 %) [18]. The dry oral environment caused by salivary hypofunction may increase the risk for developing oral conditions including candidiasis and dental caries and may contribute to oral functional complaints, such as dysphagia and chewing difficulty. Moreover, hyposalivation may be related to nutrition intake and hydration status in patients at their end of life [11, 27]. Orofacial pain assessment included self-report of facial pain, intraoral pain, mouth sores, and shooting or sharp extraoral/intraoral pains. While the mean orofacial pain frequency and severity

Table 6 Association of tissue erythema with fungal infection or ulceration/pseudomembrane

Variable		Frequency Count		Unadjusted odds ratio (95 % CI)	*p* Value
		Erythema			
		Present	Absent		
Fungal infection	Present	33	4	20.1	<.001
	Absent	19	48	(6.0, 89.0)	
		Erythema			
		Present	Absent		
Ulceration/Pseudomembrane	Present	19	2	14.1	<.001
	Absent	33	50	(3.1, 132.7)	
		Fungal infection			
		Present	Absent		
Ulceration/Pseudomembrane	Present	11	10	2.4	.08
	Absent	26	57	(0.8, 7.2)	

were low, it significantly affected oral function. This finding may be partly explained by the presence of ulcerations, which were diagnosed in 20 % of patients in our study. Patients with ulcers had significantly higher mean scores on all five OPS orofacial pain subscales than those without ulcers. Other investigators have also reported oral pain and ulceration as complaints by terminally ill patients [1, 16, 18, 28, 33]. In the series by Gordon et al., over half the patients studied experienced oral pain [16], while Jobbins et al. reported that one third of patients experienced oral pain and 12 % had ulceration [18]. Orofacial pain was also significantly associated with social impact, suggesting that the orofacial pain experienced by terminally ill patients was worrisome and affected the social interaction at this life stage.

In our study, many patients (71 %) experienced taste change when not eating and with moderate frequency (4.5± 3.6 on 0 to 10 scale). These taste alterations affected oral function, possibly related to food enjoyment, but were not reported to have a significant social impact. The presence of ulcerations and salivary hypofunction did not have a significant association with taste change. Other investigators have reported taste alterations in terminally ill patients, suggesting that it is not an uncommon complaint [16, 25]. In particular, a study of mixed advanced cancer patients followed in an outpatient nutrition–fatigue clinic reported taste and smell alterations to be the most frequent nutrition-impacting symptom (27 %) and were significantly greater compared to a control mixed cancer population without nutrition-fatigue symptoms [25]. Consequently, taste change is an important finding in advanced cancer patients and has the potential to contribute to nutritional compromise and affecting QOL.

The frequency of oral mucosal abnormalities diagnosed in our study population was relatively high, with 50 % of patients experiencing erythema, 36 % presenting with fungal infection (candidiasis), and 20 % having ulceration. The prevalence of clinical and microbiologic evidence of oral candidiasis in our study was similar to that of previous studies in advanced cancer patients [3, 8, 9, 33]. Oral fungal infection is often associated with salivary hypofunction and antibiotic use and may contribute to taste change. Further, yeast resistance to azole antifungal drugs has been reported in advanced cancer patients and may present a clinical challenge [3, 7]. While tissues with fungal infection and ulceration may be erythematous, erythema independent of these oral conditions is a clinical indicator of mucosal inflammation and may contribute to oral sensitivity and/or pain, which can impact oral function. Consequently, identification of oral conditions in patients at the end of life may offer additional strategies for management, improving patient care.

Conclusions

Our study showed that oral conditions in terminally ill patients are clinically significant and affect QOL-related functional and social activities. We used a research-driven approach combining a statistically validated oral symptom questionnaire with excellent internal consistency (Cronbach's alpha≥.70), standardized oral examination by an oral health professional, and laboratory confirmation of oral samples for microbiologic confirmation of fungal species overgrowth. These findings suggest that there is an important role for the healthcare team in identification and management of oral complaints, such as salivary hypofunction, orofacial pain, taste change, and oral mucosal abnormalities in patients with advanced cancer. These oral conditions may be interrelated, may impact social and oral function, and may contribute to nutrition and hydration needs in patients at their end of life. The importance of establishing clinical protocols and setting standards of care to identify and manage oral conditions in the terminally ill patient population is clearly warranted, given the significant clinical burden of these problems.

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Conflict of interest The authors do not have a financial relationship with the National Institutes of Health, National Institute of Nursing Research, the organization that sponsored the research. DW serves as a grant reviewer for NIH and DF now works at NIH, National Institute of Dental and Craniofacial Research (NIDCR), but this employment started after the data were collected. We have full control of all primary data and agree that the journal can have access to review our data if requested.

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