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A Preliminary Study on the Relationships between Global Health/Quality of Life and Specific Head and Neck Cancer Quality of Life Domains in Puerto Rico

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Abstract

Purpose: Health-related quality of life (HRQOL) is an important treatment outcome for head and neck cancer (HNC) patients. By ascertaining the most important HNC HRQOL issues, research and practice can be directed toward enhancing patient QOL.
Materials and Methods: A cross-sectional study of 46 ENT clinic HNC patients in Puerto Rico (PR) was completed. The European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30 (general QOL), and the QLQ-H&N35 (HNC QOL) instruments were administered. Correlations and multivariable regressions were separately conducted for QLQ-H&N35 variables on the three QLQ-C30 outcome variables: overall health, overall QOL, and the global health/QOL domain.
Results: Correlation findings included statistically significant negative correlations between the three QLQ-C30 outcome variables and the QLQ-H&N35 variables pain, swallowing, social eating, social contact, and sexuality. Multivariable linear regression identified statistically significant inverse indicators of the outcomes: (1) "lessening of sexuality" with "overall health" ($p = 0.02$), (2) "problem with social eating" ($p = 0.023$), "taking pain killers" ($p = 0.025$), and "problem with social contact" ($p = 0.035$) with "overall QOL," and (3) "problems with social eating" ($p < 0.009$) and "taking pain killers" ($p = 0.016$) with the "global health/QOL" domain.
Conclusions: We conclude that problems with pain, social eating, social interactions, and loss of sexuality are critical indicators of degraded HRQOL in HNC patients living in Puerto Rico. Our results add to the overall knowledge base regarding QOL among HNC patients. The promise of improved QOL for the HNC patient is attainable through additional research in conjunction with advances in clinical treatments and patient management protocols.

The term head and neck cancer (HNC) refers to cancers of the lip, oral cavity and pharynx (OPC), nasal cavity and paranasal sinuses, inner ear, and larynx (ICD-O C00-14, C30-32).[1] Worldwide in 2008, there were over 600,000 new cases of and more than 350,000 deaths attributable to HNC.[2] Age-standardized (world, ASR(W)) incidence and mortality rates for head and neck cancers in Puerto Rico (PR) are among the highest in the Western Hemisphere and higher than in the United States,[3] where HNC comprises 3% to 5% of all cancers.[4] The HNC most likely to be observed by prosthodontists is not only that confined to the oral cavity but also that affecting the face, eyes, ears, and external surfaces of the cranium. For males living in PR during 2008, estimated ASR(W) incidence rates were higher (8.0/100,000) than the corresponding rate in the United States (7.3/100,000). Estimated mortality rates for the same period were also elevated for males in PR (1.5/100,000) relative to the United States (1.1/100,000).[3]

Surgery remains the primary treatment for HNC and is used either alone or in combination with radiotherapy and less often, chemotherapy.[5,6] Surgery of the oral-facial structures often results in severe disfigurement and functional morbidities that can affect mastication, swallowing, and speech, which can have severe psychosocial impacts on patients and their families.[7–14] Radiation therapy-associated sequelae, such as mucositis, osteoradionecrosis, xerostomia, and local or systemic infections, may also contribute to surgical morbidity.[5] Because HNC and

its associated treatment can affect quality of life (QOL), the American Cancer Society and others have underscored the increased need for attention to health-related quality of life (HRQOL) issues in HNC patients and their families.[15,16]

QOL is a multidimensional construct that includes physical and psychological functioning, social interactions, and treatment satisfaction.[16-20] QOL encompasses a person's *subjective* feelings of satisfaction with his/her life, including general health, independence, and control, as well as being happy and fulfilled.[20-22] HRQOL assessment is based upon patient perceptions, is disease specific, and set in a cultural context.[20] HRQOL should be viewed as not just a research outcome, but *a crucial consideration in the treatment planning process* involving patients, healthcare professionals, and caregivers.[23,24] The European Organization for Research and Treatment of Cancer (EORTC) has developed a general QOL cancer questionnaire, the QLQ-C30 (Fig 1) and several disease-specific modules.[24-26] The HNC module is the QLQ-H&N35 (Fig 2).[24,27-29] While the QLQ-H&N35 provides information on specific signs and symptoms related to disease and treatment sequelae, reports dealing with HNC QOL issues in relation to general HRQOL and health are sparse. Three reports have assessed correlations between QOL domains, as measured by the EORTC H&N35 and other global health and QOL scores.[30,28,31]

Zwahlen et al reported correlations between the WHO global QOL-BREF domain score and various domains measured via the EORTC H&N35.[30] Significant inverse correlations with global QOL were reported for swallowing ($r = -0.46$), social eating ($r = -0.65$), social contact ($r = -0.38$), and sexuality ($r = -0.49$). Based upon separate studies involving different United States and North-European populations, Sherman et al[31] and Bjordal et al[28] reported similar findings when they correlated global health/QOL based upon the EORTC QLQ-C30 with EORTC H&N35 domains for swallowing (correlation coefficients reported for Refs 31 and 28, respectively: −0.40, −0.41), social eating (−0.56, −0.43), social contact (−0.48, −0.41), sexuality (−0.35, −0.38), pain (−0.42, −0.44), speech (−0.55, −0.35), and senses (−0.29, −0.41).

While these above correlational findings represent an important step in understanding relationships between global QOL and issues faced by HNC patients, multivariable predictive analyses are needed to help disentangle the independent effects of multiple predictors on QOL. Such analyses will not only augment the existing QOL knowledge base as regards HNC patients, it will also strengthen the foundation needed to improve technologies, procedures, and support services to effectively enhance HRQOL in HNC cancer patients. The purpose of the current preliminary study was to use multivariable regression to screen for which of the QOL symptoms and domains (as quantified by the EORTC H&N35) had the greatest impact on measures of health and QOL (as evaluated by the EORTC QLQ-C30) among HNC patients living in Puerto Rico.

Materials and methods

Study operations

The protocol for the current preliminary cross-sectional study was approved by the University of Puerto Rico Medical Sciences Campus (UPRMSC) Institutional Review Board. During the period from July to October 2007, 46 participants were recruited from the ENT Head and Neck Oncology Clinic at the UPRMSC. All consecutive patients presenting for care at the clinic were assessed for inclusion in the study. Persons diagnosed with an HNC were eligible for inclusion if they were at least 21 years of age, spoke Spanish, were born in PR, had lived on the island for at least 10 years, and were a current PR resident. Patients expected to have a short survival time and persons with cognitive and/or mental impairment, as determined by the attending physician, were excluded. At the time of study participation, participants were either pre-, intra-, or posttreatment.

Written informed consent was obtained from all participants in a private room following their clinic visit. Subsequently, sociodemographic information was obtained, and the PR versions of both the EORTC QLQ-C30 (general QOL) and QLQ-H&N35 were self-administered. A trained interviewer was available to assist with reading when necessary.

Study instruments

Three structured data collection instruments were used. A sociodemographic questionnaire obtained information on age, gender, education, years of continuous residence in PR, and marital status. In addition, two QOL questionnaires developed by the EORTC, that is, the QLQ-C30 and the QLQ-H&N35 were used (Figs 1 and 2). The QLQ-C30 is a general cancer HRQOL questionnaire that is multidimensional, appropriate for self-administration, applicable across cultural settings, and available in 81 languages.[24] The instrument assesses five functional domains (physical, role, cognitive, emotional, social), has three symptom scales (fatigue, pain, emesis), contains an item measuring perception of overall QOL and an item measuring perception of overall health, and has a global health/QOL domain comprised of the two items "overall QOL" and "overall health." For each functional domain and symptom item, participants are asked to respond using a score ranging from "not at all" (scored 1) to "very much" (scored 4). For example, under the QLQ-C30 heading "During the past week," item #8 asks "were you short of breath?" The three outcome variables used for the study reported here are the two component items of the QLQ-C30 summary domain ("overall QOL" and "overall health") and the domain "global health and QOL." The two items of the domain are item #29, "how would you rate your overall health during the past week?" and item #30, "how would you rate your overall quality of life during this past week?" These items allow for responses ranging from "very poor" (scored 1) to "excellent" (scored 7). Domains and symptom items are converted to a 0 to 100 scale, with higher scores for *domains* indicative of more favorable status and higher scores for *symptom* scales indicating a worse status than lower scores.

The QLQ-H&N35, the HNC-specific HRQOL questionnaire, is available in 48 languages[24] and contains 35 questions of which 24 are component items of 7 domains (pain, swallowing, senses, speech, social eating, social contact, sexuality), and 11

EORTC QLQ-C30 (version 3)

We are interested in some things about you and your health. Please answer all of the questions yourself by circling the number that best applies to you. There are no "right" or "wrong" answers. The information that you provide will remain strictly confidential.

Please fill in your initials: ⌊ ⌋⌊ ⌋⌊ ⌋

Your birthdate (Day, Month, Year): ⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋

Today's date (Day, Month, Year): 31 ⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋⌊ ⌋

	Not at All	A Little	Quite a Bit	Very Much
1. Do you have any trouble doing strenuous activities, like carrying a heavy shopping bag or a suitcase?	1	2	3	4
2. Do you have any trouble taking a long walk?	1	2	3	4
3. Do you have any trouble taking a short walk outside of the house?	1	2	3	4
4. Do you need to stay in bed or a chair during the day?	1	2	3	4
5. Do you need help with eating, dressing, washing yourself or using the toilet?	1	2	3	4

During the past week:	Not at All	A Little	Quite a Bit	Very Much
6. Were you limited in doing either your work or other daily activities?	1	2	3	4
7. Were you limited in pursuing your hobbies or other leisure time activities?	1	2	3	4
8. Were you short of breath?	1	2	3	4
9. Have you had pain?	1	2	3	4
10. Did you need to rest?	1	2	3	4
11. Have you had trouble sleeping?	1	2	3	4
12. Have you felt weak?	1	2	3	4
13. Have you lacked appetite?	1	2	3	4
14. Have you felt nauseated?	1	2	3	4
15. Have you vomited?	1	2	3	4
16. Have you been constipated?	1	2	3	4

Please go on to the next page

Figure 1 EORTC QLQ-C30 quality of life cancer survey.

During the past week:	Not at All	A Little	Quite a Bit	Very Much
17. Have you had diarrhea?	1	2	3	4
18. Were you tired?	1	2	3	4
19. Did pain interfere with your daily activities?	1	2	3	4
20. Have you had difficulty in concentrating on things, like reading a newspaper or watching television?	1	2	3	4
21. Did you feel tense?	1	2	3	4
22. Did you worry?	1	2	3	4
23. Did you feel irritable?	1	2	3	4
24. Did you feel depressed?	1	2	3	4
25. Have you had difficulty remembering things?	1	2	3	4
26. Has your physical condition or medical treatment interfered with your family life?	1	2	3	4
27. Has your physical condition or medical treatment interfered with your social activities?	1	2	3	4
28. Has your physical condition or medical treatment caused you financial difficulties?	1	2	3	4

For the following questions please circle the number between 1 and 7 that best applies to you

29. How would you rate your overall health during the past week?

1	2	3	4	5	6	7
Very poor						Excellent

30. How would you rate your overall quality of life during the past week?

1	2	3	4	5	6	7
Very poor						Excellent

Figure 1 Continued.

are additional items (i.e., symptoms outside the listed domains), for example, hoarseness, taking pain killers, and tooth problems (Table 1). Generally used in conjunction with the QLQ-C30, the H&N35 questions continue the C30 numbering sequence, that is, the first QLQ-H&N35 question is not #1, but #31. Responses for 30 items range from "not at all" (scored 0) to "very much" (scored 4) with the remaining 5 items scored "yes" or "no." For example, item #39 asks, "during the past week, have you had problems with your teeth?" (4-point scale), and item #48 asks, "during the past week, have you used pain-killers?" (yes/no).

EORTC QLQ - H&N35

Patients sometimes report that they have the following symptoms or problems. Please indicate the extent to which you have experienced these symptoms or problems during the past week. Please answer by circling the number that best applies to you.

During the past week:		Not at all	A little	Quite a bit	Very much
31.	Have you had pain in your mouth?	1	2	3	4
32.	Have you had pain in your jaw?	1	2	3	4
33.	Have you had soreness in your mouth?	1	2	3	4
34.	Have you had a painful throat?	1	2	3	4
35.	Have you had problems swallowing liquids?	1	2	3	4
36.	Have you had problems swallowing pureed food?	1	2	3	4
37.	Have you had problems swallowing solid food?	1	2	3	4
38.	Have you choked when swallowing?	1	2	3	4
39.	Have you had problems with your teeth?	1	2	3	4
40.	Have you had problems opening your mouth wide?	1	2	3	4
41.	Have you had a dry mouth?	1	2	3	4
42.	Have you had sticky saliva?	1	2	3	4
43.	Have you had problems with your sense of smell?	1	2	3	4
44.	Have you had problems with your sense of taste?	1	2	3	4
45.	Have you coughed?	1	2	3	4
46.	Have you been hoarse?	1	2	3	4
47.	Have you felt ill?	1	2	3	4
48.	Has your appearance bothered you?	1	2	3	4

Please go on to the next page

Figure 2 EORTC QLQ-H&N35 quality of life head and neck-specific cancer survey module.

During the past week:		Not at all	A little	Quite a bit	Very much
49.	Have you had trouble eating?	1	2	3	4
50.	Have you had trouble eating in front of your family?	1	2	3	4
51.	Have you had trouble eating in front of other people?	1	2	3	4
52.	Have you had trouble enjoying your meals?	1	2	3	4
53.	Have you had trouble talking to other people?	1	2	3	4
54.	Have you had trouble talking on the telephone?	1	2	3	4
55.	Have you had trouble having social contact with your family?	1	2	3	4
56.	Have you had trouble having social contact with friends?	1	2	3	4
57.	Have you had trouble going out in public?	1	2	3	4
58.	Have you had trouble having physical contact with family or friends?	1	2	3	4
59.	Have you felt less interest in sex?	1	2	3	4
60.	Have you felt less sexual enjoyment?	1	2	3	4

During the past week:		No	Yes
61.	Have you used pain-killers?	1	2
62.	Have you taken any nutritional supplements (excluding vitamins)?	1	2
63.	Have you used a feeding tube?	1	2
64.	Have you lost weight?	1	2
65.	Have you gained weight?	1	2

Figure 2 Continued.

As with the QLQ-C30, QLQ-H&N35, domains and items (i.e., symptoms) are scaled (0 to 100); however, higher scores for all QLQ-H&N35 domains and symptoms are indicative of a less favorable status.

Data management

All data were double entered and subjected to accuracy checks. Potential data errors were examined by comparing the original

Table 1 EORTC QLQ-C30 and QLQ-H&N35 Questionnaire domains and items

		Item/domain	Notes
Dependent variable QLQ-C30	Items	Overall health (self-rated)	
		Overall QOL (self-rated)	
	Domain	Global health status / QOL	Standardized scaled domain composed of: 1. overall health (self-rated) 2. overall QOL (self-rated)
Independent QLQ-H&N35	Items	Problems with teeth	
		Problems with opening mouth wide	
		Dry mouth	
		Sticky saliva	
		Cough	
		Used pain killers	
		Taken nutritional supplements	
		Used a feeding tube	
		Weight loss	
		Weight gain	
	Domains	Pain	
		Swallowing	
		Sense problems	
		Speech problems	
		Trouble with social eating	
		Trouble with social contact	
		Less sexuality	

data sheets with the entered data. The database was imported into SPSS with graphing and frequency counts used to identify missing data and outliers. Standardized (0 to 100) scores for the domains and individual items (symptom questions) were computed from the raw item scores using the EORTC domain computational algorithm. The two items composing the "global health and QOL" domain were analyzed based upon the self-reported scores (1 to 7).

Analysis

Figure 3 presents the data operations flow-sheet. The three QLQ-C30-based outcome variables were self-reported "overall health," self-reported "overall QOL," and the "global health / QOL" domain. Pearson correlation coefficients were estimated for the relationships between the QLQ-C30 outcome variables and the 7 QLQ-H&N35 domains.

The initial unadjusted correlation analyses were followed by stepwise multivariable linear regression, that is, each variable was added to and then removed from the equation in multiple sequential iterations. A variable was permanently excluded from the model if it did not achieve a p-value ≤ 0.05 in any combination with any other variable(s). In the multivariable regressions, the three QLQ-C30 variables were regressed separately on the 7 *domains* and 10 *items* not comprising a domain from the QLQ-H&N35 as well as age, gender, and phase of treatment. One item ("during the past week have you felt ill?") was not included in any model because of the rather vague meaning of the question and the potential that the response could reflect an acute, transient illness. Therefore, interpreting the results based upon this variable would be difficult, if not impossible. The forward and backward stepwise linear regressions, which are both variations of stepwise modeling**,** were conducted using a criterion of $p \leq 0.05$ for variable inclusion/exclusion; no variables having a p-value >0.05 were retained in the final model. Additionally, analyses were conducted by forcing demographic variables into the final model.

Results

Forty-six patients with a diagnosis of HNC were included in the study (Table 2), 11 men in pretreatment, 19 men and 4 women undergoing treatment, and 9 men and 3 women in posttreatment. The mean age of the participants was 60.3 years, and 85% were male. The mean score for the global health/QOL domain was 56.2, while mean scores for the overall health and overall QOL items (range 1 to 7) were 4.4 and 4.3.

Table 3 presents the correlation matrix for the QLQ-H&N35 domain variables and QLQ-C30 outcomes of interest, that is, the overall health and overall QOL items, and global health/QOL domain). Five of the seven QLQ-H&N35 domain variables (pain, swallowing, social eating, social contact, and sexuality) had statistically significant negative correlations with all three QLQ-C30 outcome variables. For example, the QLQ-H&N35 domains of pain and swallowing had correlation coefficients of $r = -0.43$ ($p = 0.003$) and $r = -0.42$ ($p = 0.004$), respectively, with the QLQ-C30 item "overall health." That is, reported "overall health" declined with increased self-perceived pain and difficulties with swallowing. In addition to the five QLQ-H&N35 domains identified above as being significantly inversely correlated with the each of QLQ-C30 outcomes of interest, the QLQ-H&N35 speech domain was also negatively

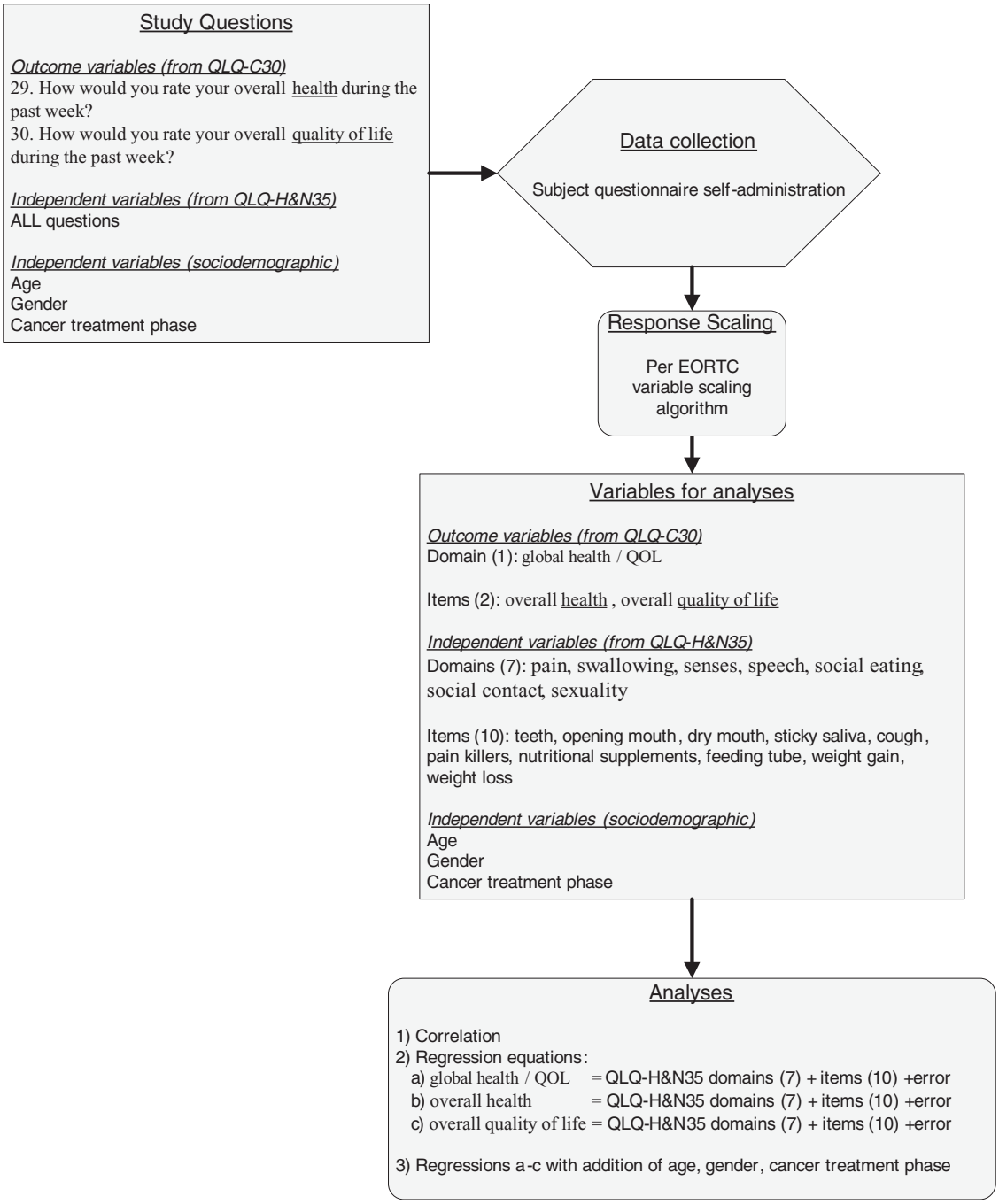

Figure 3 Data operations.

correlated with both the QLQ-C30 item "overall QOL" and domain "global health / QOL" ($p < 0.05$) while the senses domain was inversely correlated with "overall QOL" ($p = 0.03$)

The multivariable forward and backward stepwise regressions produced identical final models (Table 4). Variables included in the table are limited to those with a significance level of <0.05. In model 1, the QLQ-C30 self-rated "overall health" item was negatively correlated with "sexual problems" ($p = 0.02$); that is, the greater the perceived sexual problem, the lower the "overall health" score. For self-rated "overall QOL" (model 2) "problems with social eating" ($p = 0.023$), "problems with social contact" ($p = 0.035$), and "taking pain killers" ($p = 0.025$) were all inversely associated with QOL. Both "problems with social eating" ($p < 0.009$) and "taking pain killers" ($p = 0.016$) were statistically significant negative predictors of "global health / QOL" (model 3).

Table 2 Descriptive statistics for the 46 HNC patients in Puerto Rico: demographics and health/QOL by treatment status

Variables	Pretreatment	In treatment	Posttreatment	Total	*p*-value
Gender (n, %)					0.272[a]
Male	11(100%)	19(82.6%)	9(75%)	38(84.8%)	
Female	0(0%)	4(17.4%)	3(25%)	7(15.2%)	
Total	11	23	12	46	
Mean age (s.d.)	59.4(10.3)	59.8(10.7)	61.3(10)	60.3(10)	0.681[b]
Mean score (s.d.)					
Global health/QOL domain (range: 0–100)	56(23.3)	50.7(25.5)	66.7(37.1)	56.2(28.6)	0.176[b]
Overall health (range = 1–7)	4.2(1.4)	4.3(1.6)	4.9(2.2)	4.4(1.7)	0.382[b]
Overall QOL (range = 1–7)	4.6(1.8)	3.8(1.8)	5.1(2.2)	4.3(2)	0111[b]

[a]Based on Fisher's exact test.

[b]Based on Kruskal-Wallis test.

Table 3 Correlation matrix for the EORTC QLQ C-30 health status and QOL variables with the QLQ-H&N35 items

Item/domain		Overall health	Overall QOL	Global health/QOL	Pain	Swallowing	Senses	Speech	Social eating	Social contact	Sexuality
QLQ-C30											
Overall health	R	1.00	0.76	0.93	−0.43	−0.42	−0.15	−0.28	−0.42	−0.31	−0.46
	p-value		0.000	0.000	0.003	0.004	0.318	0.061	0.004	0.037	0.001
Overall QOL	R		1.00	0.95	−0.30	−0.45	−0.32	−0.43	−0.55	−0.51	−0.47
	p-value			0.000	0.043	0.002	0.032	0.003	0.000	0.000	0.001
Global health/QOL	R			1.00	−0.38	−0.46	−0.26	−0.38	−0.52	−0.44	−0.50
	p-value				0.009	0.001	0.088	0.009	0.000	0.002	0.000
QLQ-H&N35											
Pain	R				1.00	0.63	0.23	0.34	0.56	0.36	0.55
	p-value					0.000	0.124	0.020	0.000	0.014	0.000
Swallowing	R					1.00	0.44	0.59	0.84	0.43	0.55
	p-value						0.002	0.000	0.000	0.003	0.000
Senses	R						1.00	0.24	0.37	0.26	0.39
	p-value							0.115	0.012	0.088	0.008
Speech	R							1.00	0.64	0.65	0.44
	p-value								0.000	0.000	0.002
Social eating	R								1.00	0.57	0.57
	p-value									0.000	0.000
Social contact	R									1.00	0.50
	p-value										0.000
Sexuality	R										1.00

To assess whether the estimated regression coefficients reported in Table 4 were confounded by age, gender, or treatment phase, we forced the latter variables into each of the three lower order models that included only those variables reported in the table. With just one exception, each of the age-, gender- and treatment phase-adjusted regression coefficients remained essentially unchanged from those presented in Table 4. The one exception was observed in model 2, in which the coefficient for "problems with social contact" changed from −0.018 to −0.013, with a concomitant change in the significance level of the variable from $p = 0.016$ to $p = 0.15$.

Discussion

The bivariate correlation findings are consistent with those of previous reports. Zwahlen et al found that swallowing, social eating, social contact, and sexuality were correlated with QOL as quantified by the WHO QOL measure.[30] Similarly, Sherman et al and Bjordal et al reported statistically significant correlations between EORTC global QOL and swallowing, social eating, social contact, and sexuality, as well as speech and pain.[28,31] In our analysis, pain, swallowing, speech, social eating, social contact, and sexuality were all negatively correlated with "global health/QOL." Moreover, the correlation coefficients either approached or exceeded −0.40 and were highly statistically significant. Notably, "global health / QOL" was most strongly correlated with "social eating" and "sexuality" (both correlation coefficients ≥−0.50), and the same items had noteworthy correlations ($r > -0.40$) with both "overall health" and "overall QOL." These findings imply the critical importance of social eating and sexuality in the HRQOL among HNC patients.

Table 4 Multivariable models evaluating the relationship between EORTC QLQ-H&N35 indicator variables and EORTC QLQ-C30 outcome measures, based upon stepwise linear regressions

Outcome measure (QLQ-C30)	Indicator variables (QLQ-H&N35)	Coefficient	*p*-value	r	r-sq-adjusted
Model 1					
Overall health (item)				0.45	0.18
	Intercept	5.3			
	Sexual problems	−0.02	0.02		
Model 2					
Overall QOL (item)				0.66	0.39
	Intercept	6.51			
	Problem with social eating	−0.02	0.023		
	Problem with social contact	−0.02	0.035		
	Taking "pain killers"	−0.01	0.025		
Model 3					
Global health/QOL (domain)				0.6	0.33
	Intercept	87.03			
	Problem with social eating	−0.36	< 0.009		
	Taking "pain killers"	−0.19	0.016		

Multivariable regression was used to determine which symptom items in the QLQ-H&N35 (e.g., pain, swallowing), were the most important indicators of self-assessed "overall health," "overall QOL," and the domain "global health/QOL." Because demographic variables could confound the relationships of interest, variables for age, gender, and treatment phase were included in our models. Overall, the findings from the multivariable regressions demonstrate that among HNC patients, problems with pain (as measured by taking pain killers), social eating, and problems with sexuality are *prominent* indicators of degraded HRQOL, with socialization difficulties a likely contributing factor.

The effect of identified independent variables on QOL can be considerable. For example, in model 2 (Table 4) in which the dependent variable is "overall QOL" (a QLQ-C30 item scored 1 to 7), the independent variable "problem with social contact" (a QOL-H&N35 domain scaled 0 to 100) has a regression coefficient of −0.02. While the coefficient appears small, its impact can be quite large. For those respondents who scored 75 (out of 100) for the QOL-H&N35 domain "problem with social contact," there is a corresponding 21% reduction in overall QOL. Further, because each other coefficient in the model has a negative value, those variables would also contribute to a decrease in the estimated "overall QOL" (see Appendix for example calculations).

Sexuality was the only variable statistically associated with the self-assessed "overall health" status question; however, the cross-sectional nature of the study limits our ability to determine whether poor health limited sexual satisfaction, or sexual difficulties affected sense of health. An inverse relationship between degraded sexuality and self-assessed health has also been reported in previous studies.[30,32] Treatment-related problems affecting sexual satisfaction in HNC patients require further research to identify those patients at risk and to design optimum treatment and/or support strategies.

Likewise, our understanding of the pain management domains could benefit from a detailed exploration into the quantity, quality, and source of pain, as well as risk factors and modifying personal and environmental characteristics that can influence the impact of pain on HRQOL. When the manifestation and management of pain in HNC patients is better understood, the opportunity will exist to dramatically impact the QOL in many HNC patients.

Our findings on social eating and social interaction can be interpreted as suggesting that research be directed to the area of rehabilitation. The results also highlight the need to focus on surgical reconstructive techniques using the concepts of tissue engineering and artificial rehabilitative procedures, including improved prostheses, and integrated clinical activities that optimize operations, systems, and protocols for patients with specific QOL problems. An efficient means of coordinating the necessary care is critical. In a first systematic step to accomplish this goal, Rogers and Lowe reported on an approach to identify patients in need of referral by defining domain score trigger points for referral based upon the University of Washington Quality of Life Questionnaire (UWQOL).[33]

Two primary limitations of this preliminary study are its relatively small size and the aggregate analysis of cancer patients at several points along the postdiagnostic pathway. Despite the limited sample size with its corresponding low statistical power, *statistically significant* predictors were identified in the three multivariable models (Table 4). Further, regression coefficients can be interpreted as suggesting relatively strong effects and thereby highlight the importance of the identified variables in terms of the associated outcomes of interest for this mix of patient characteristics. On the other hand, the initial screening model containing the full set of independent variables was not powered to detect ALL significant associations, and some meaningful relationships may not be identified.

Although an aggregate analysis of persons at different points of treatment would intuitively suggest a tendency toward producing correlation coefficients and regression parameter estimates shifted toward the null, or no effect, it is noteworthy that we still found statistically significant HNC QOL factors,

suggesting the importance of the identified indicators on QOL across the treatment spectrum. Larger samples are required to better understand the importance of the various predictors across the treatment phases and to identify treatment group differences.

Conclusions

Critical indicators of diminished QOL in HNC patients living in Puerto Rico were problems related to pain, social eating, social interactions, and loss of sexuality. These findings add knowledge regarding QOL among HNC patients. The promise of improved QOL for the HNC patient is attainable through additional research in conjunction with advances in clinical treatments and patient management protocols. Dentists, particularly prosthodontists, may be central in this effort.

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Appendix

Based on parameter estimates presented in Table 4 and given specific indicator variable scores obtained from the QLQ-H&N35, one can calculate expected values for each of the three QLQ-C30 outcome measures of interest. For models 1 to 3, each coefficient has a negative value indicating that with each unit increase in the score of the respective indicator variable there will be a corresponding reduction in the magnitude of the outcome measure. For example, to estimate the percent reduction in "overall QOL" (model 2, Table 4) for respondents scoring 75 (out of 100) on the "problem with social contact" domain (a QLQ-H&N35 domain scaled 0 to 100), one first multiplies the value of the variable coefficient (−0.02) by the "problem with social contact" score (75) (i.e., $-0.02 * 75$) and obtains a value of −1.5, which represents the decline in "overall QOL" on a scale of 1 to 7. In percentage terms, the value −1.5 indicates a 21% reduction (−1.5 points/7 point score = −0.21) from the best possible "overall QOL" score.

Because each coefficient in model 2 (Table 4) has a negative value, each variable contributes to a decrease in the estimated "overall QOL." For participants who scored (a) 75 on the "problem with social contact" domain, (b) 100 for "taking pain killers" (scored 0 for "no" and 100 for "yes"), and (c) 50 for "social eating" (scored 0 to 100), the estimated "overall QOL" score would be 3.0 out of 7.0 [i.e., $6.51 + (-0.02*75) + (-0.01*100) + (-0.02*50)$].