

Predictors of Quality of Life for Head and Neck Cancer Patients at an Academic Institution

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Abstract

Objective. Quality of life (QOL) is an important consideration in head and neck cancer (HNC) due to lasting disease and treatment-related toxicities. We performed a comprehensive review of predictors of QOL in this population, including distance to care.

Study Design. Retrospective cohort study from 2017 to 2022.

Setting. Academic medical center.

Methods. QOL was quantified in patients treated for HNC utilizing the University of Washington Quality of Life and 20-Item Short Form surveys completed at subsequent clinic visits. Distance to treatment center and other demographic, socioeconomic, disease-specific, and behavioral data were analyzed.

Results. There were 176 patients in the cohort (69% male; mean age, 64 ± 10.8 years). There was no association between miles traveled and any of the QOL subscales. Marital status was the strongest predictor of QOL, significantly associated with 7/8 QOL domains and favoring those who were married. Other significant predictors of decreased QOL included emotional/physical abuse, current tobacco use, documented religious affiliation, and treatment involving surgery plus adjuvant therapy. A significant positive trend over time existed for multiple QOL subscales.

Conclusion. QOL is unchanged in patients who travel greater distances for care. QOL is more closely linked to factors such as marital status, physical/emotional abuse, tobacco use, religious affiliation, treatment intensity, and time following surgery. This highlights the importance of a strong support structure and the influence of certain socioeconomic and lifestyle factors on patients, with opportunities for screening and intervention throughout their cancer care.

Keywords

abuse, distance, head and neck cancer, quality of life, racial disparity, social support

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Head and neck cancer (HNC) management requires a multidisciplinary approach.¹ Traveling greater distances for care is associated with improved overall survival in these patients, however the reasons why are unclear.^{2,3} Some suggest that those traveling further are more likely to receive therapy at academic and high-volume treatment centers, with a push for creating centers of excellence.⁴⁻⁷ Other single-center studies and those controlling for treatment centers have reported that the relationship between distance and overall survival persists, suggesting that it may be mediated by more than facility quality and volume alone.^{3,8} Increased survival in patients who travel further despite receiving the same care has been referred to as “distance bias” or “referral bias.”⁸

Patients with HNC face unique challenges because the disease and treatment can result in deformities or loss of function (eg, speaking, eating) that carry profound psychosocial ramifications.⁹ As there have been significant improvements in overall survival for HNC,¹⁰ accounting for the lasting physical, social, and emotional effects on patients is increasingly important. Quality of life (QOL) is a multidimensional patient-centered variable that encompasses these aspects of an individual's life and overall well-being.⁹ It is viewed in the same light as overall survival in terms of its importance for patients with HNC and can help

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guide clinical decision-making and identification of patients in need of additional support.^{11,12}

The objective of this study was to determine whether an association exists between miles traveled and QOL, along with other demographic, socioeconomic, behavioral, and disease-specific factors in patients with HNC.

Methods

Study Variables

The primary outcome was QOL, measured utilizing self-administered University of Washington Quality of Life (UWQOL) and 20-Item Short Form (SF-20) surveys. UWQOL is a head and neck-specific questionnaire suitable for health-related QOL evaluation in the clinical setting.¹³ UWQOL questions were grouped into 2 subscales: physical function and social/emotional function.¹⁴ The physical function subscale included the domains chewing, swallowing, speech, taste, saliva, and appearance. The social/emotional subscale included the domains anxiety, mood, pain, activity, recreation, and shoulder function. SF-20 is a general health survey not specific to HNC, with questions categorized into the subscales physical functioning, role functioning, social functioning, mental health, health perceptions, and pain.¹⁵

All patients received care at the same high-volume tertiary/quaternary care academic hospital, and distance to the treatment center was calculated in miles using the home addresses of the patients listed in the electronic medical record. Other patient variables obtained from the electronic health record for analysis included age at the time of the first survey, sex, race, ethnicity, marital status, number of others in the household, emotional or physical abuse, tobacco or alcohol use, religious status, insurance type, primary tumor site, disease stage, and treatment type. Race was categorized as white or non-white due to small counts for other races, marital status as married, widowed, single/never married, or divorced, tobacco use as current, former, or never, alcohol use as daily, former, social, or never/rarely, religious status as religious or not religious based on documentation of a religious affiliation, and insurance type as private, Medicare/Medicaid, or self-pay. Records of physical or emotional abuse and the number of others in the household were obtained from a patient intake form located in the medical record. Patients diagnosed before January 1, 2018, were staged using the American Joint Committee on Cancer (AJCC) 7th edition guidelines, while disease stage after this date was classified according to the AJCC 8th edition staging manual. Treatment was cataloged as radiation, surgery, chemoradiation, and surgery plus additional treatment, which included adjuvant chemoradiation, radiation, chemotherapy, or radiation and immunotherapy.

Sample and Data Collection

This study was classified as exempt by the Penn State Hershey Medical Center Institutional Review Board, and

the need for informed consent was waived. Using the International Classification of Diseases-10 disease codes, 176 patients were identified who were treated for HNC and completed at least 1 UWQOL and SF-20 survey during the years 2017 to 2022. The questionnaires were self-reported by patients predominantly throughout their scheduled posttreatment surveillance follow-ups and were scanned into the medical record. Individual survey responses as well as other data were entered into a secure online database prior to analysis.

Statistical Analysis

Individual questions from UWQOL and SF-20 were scored by scaling each response from 0 to 100, with 0 being the worst and 100 indicating the highest QOL. The exception was the SF-20 pain subscale, in which 0 represented the least pain. Subscales were calculated based on the instructions in the original publications of the instruments. Since the distance to the treatment center was quantitative and QOL could potentially be measured at multiple time points for patients who completed multiple pairs of surveys, mixed-effect repeated measures linear regression models were used to determine whether an association existed for each of the UWQOL and SF-20 subscales with subject as a random effect, controlling for a time as a covariate. A sample size of 176 participants was needed to provide 80% power to detect a slope of approximately 0.15 as statistically significant for the association between distance to the treatment site and QOL, assuming a 2-sided test and $\alpha = .05$.

Multivariable analyses were conducted to determine whether associations existed between each of the documented variables and QOL domains, as well as temporal trends. Due to the number of variables in these analyses, a reduced model was created for each QOL subscale after removing nonsignificant factors one at a time in a manual backward selection process until all $P < .05$. Any instances of missing data were excluded from this model.

To evaluate potential reporting bias, that is, the possibility that patients who were doing well filled out more surveys than those who were doing poorly, an additional analysis determined whether there was an association between belonging to different subcategories for each variable collected and the number of surveys completed. The Kruskal-Wallis P value was calculated for the number of surveys completed according to each variable collected.

Significance was defined as $P < .05$, and analysis was conducted utilizing SAS statistical software version 9.4 (SAS Institute Inc). In accordance with Ringash et al,¹⁶ clinical significance was defined as a 10% difference in the instrument range. The presence of an exposure-response relationship also supported clinical significance.

Results

One hundred seventy-six patients with HNC were included in the analysis. A majority of patients were male, white, and not Hispanic or Latino. Relevant

Table 1. Demographics and Health Behaviors of Sample

Variable	No. (%) (n = 176)
Age	64 ± 10.8
Sex	
Male	122 (69.3%)
Female	54 (30.7%)
Race	
White	162 (92.6%)
Non-white	13 (7.4%)
Unknown	1
Ethnicity	
Not Hispanic or Latino	170 (96.6%)
Multiple or Hispanic	6 (3.4%)
Marital status	
Married	93 (52.8%)
Widowed	18 (10.2%)
Single/never married	34 (19.3%)
Divorced	31 (17.6%)
Number of others in the household	
0	45 (25.6%)
1	89 (50.6%)
2	25 (14.2%)
3+ or other	17 (9.7%)
Emotional or physical abuse	
No	164 (93.2%)
Yes	12 (6.8%)
Tobacco use	
Never	41 (23.3%)
Former	78 (44.3%)
Current	57 (32.4%)
Alcohol use	
Rarely/never	58 (33.0%)
Social	70 (39.8%)
Former	20 (11.4%)
Daily	28 (15.9%)
Religious status	
Not religious	99 (56.3%)
Religious	77 (43.8%)
Insurance type	
Private	105 (61.1%)
Medicare/Medicaid	61 (35.5%)
Self-pay	6 (3.5%)
Unknown	4

Columns may not add to 100% due to rounding.

demographics, health behaviors, and hospital, oncologic, and treatment characteristics of the sample are presented in **Tables 1** and **2**. Patients completed an average of 2 ± 1.7 pairs of UWQOL and SF-20 surveys (minimum [Min]: 1, maximum [Max]: 11). Patients completed their first surveys a median of 195 days after the documented date of treatment completion (mean \pm SD: 391 ± 624 days). For those who completed a second pair of surveys, they did so a median of 177 days after their first surveys (mean \pm SD: 278 ± 282 days). Subsequent surveys were

Table 2. Hospital, Oncologic, and Treatment Characteristics of Sample

Variable	No. (%) (n = 176)
Treating facility type	
Academic medical center	176 (100%)
Distance to the treatment center	37.6 ± 28.4 miles
Primary tumor site	
Oropharynx	66 (37.5%)
oral cavity	72 (40.9%)
Nasal cavity/paranasal sinuses	4 (2.3%)
Nasopharynx	5 (2.8%)
Hypopharynx	3 (1.7%)
Larynx	23 (13.1%)
Unknown primary	3 (1.7%)
Disease stage	
1	37 (21.3%)
2	24 (13.8%)
3	32 (18.4%)
4	81 (46.6%)
Unknown	2
Treatment	
Chemoradiation	57 (32.3%)
Radiation	4 (2.3%)
Surgery	28 (16.0%)
Surgery+	87 (49.4%)

Columns may not add to 100% due to rounding.

Surgery+ indicates surgery plus additional treatment, which includes adjuvant chemoradiation, radiation, chemotherapy, or radiation and immunotherapy.

conducted with a median of 180 days apart from one another (mean \pm SD: 228 ± 189 days).

Relationship Between Distance and QOL Subscales

Overall, the mean distance traveled to the treatment center was 37.6 miles (SD 28.4, median 32.0, Q1-Q3: 15.0-51.3). The maximum distance traveled was 155 miles, and the minimum was 2 miles. There were no significant associations between distance and any of the UWQOL or SF-20 domains of QOL, adjusted for survey responses over time ($P > .05$) (**Table 3**). Distance persisted as not significant on multivariable analysis after adjusting for covariates ($P > .05$).

Demographic Factors

Age and sex were not significant predictors of any QOL domains ($P > .05$). For race and ethnicity, it must be noted that there were only 13 non-white patients and 6 Hispanic or Latino patients in the study cohort, therefore valid statistical analyses to prove significance could not be performed. However, race appeared to influence the UWQOL social/emotional and SF-20 physical functioning subscales, with greater QOL reported for white versus non-white races (**Table 4**). Ethnicity also appeared

Table 3. Association Between Distance to Treatment Center and QOL Subscales

Survey subscale	Association with miles from treatment site	
	β	<i>P</i> value
UWQOL		
Physical	-.01	.80
Social/emotional	-.05	.30
SF-20		
Physical functioning	-.05	.60
Role functioning	.05	.67
Social functioning	.01	.94
Mental health	-.07	.16
Health perceptions	-.03	.61
Pain	.02	.83

Abbreviations: QOL, quality of life; SF-20, 20-Item Short Form; UWQOL, University of Washington Quality of Life.

to influence the UWQOL physical subscale, favoring patients who were not Hispanic or Latino.

Marital Status and Number of Others in Household

Marital status was a significant overall predictor of UWQOL social/emotional ($P < .001$), and SF-20 physical ($P < .001$), role ($P < .001$), social ($P < .001$), mental health ($P < .001$), health perceptions ($P = .03$), and pain ($P = .006$) subscales (**Table 4**). Patients who remained married consistently reported increased QOL compared to those who were widowed, followed by single/never married and divorced. Despite this finding, there were no significant associations between living with others in the household and QOL domains ($P > .05$).

Emotional or Physical Abuse

There were 9 women (16.6% of all women) and 3 men (2.5% of all men) who indicated that they were experiencing emotional or physical abuse. These patients had significant decreases in the SF-20 mental health ($P < .001$) and UWQOL social/emotional ($P < .001$) subscales, and increased SF-20 pain ($P < .001$) (**Table 4**).

Tobacco and Alcohol Use

Tobacco use was a negative predictor of multiple domains of QOL (**Table 4**). Patients who were currently using tobacco at the time of survey administration reported decreased QOL compared to those who quit or never used ($P = .04$ for UWQOL physical, $P = .01$ for UWQOL social/emotional, $P = .047$ for SF-20 pain, and $P = .01$ for SF-20 perceptions). Patients who rarely/never consumed alcohol reported decreased SF-20 pain scores compared to those who were social drinkers or were formerly heavy drinkers ($P = .007$); however, their scores were not different from those who consumed alcohol daily.

Religious Status

Patients from 16 different religious denominations were represented in the sample. Of those who were religious, all but 2 were affiliated with Christianity. The most common denominations were Protestant ($n = 28$), Catholic ($n = 24$), and Lutheran ($n = 12$).

Patients who reported a religious affiliation had decreased QOL scores compared to those who did not ($P = .03$ for SF-20 physical, $P = .01$ for SF-20 social, and $P < .001$ for SF-20 pain) (**Table 4**).

Disease Factors

There were no significant associations between tumor site or disease stage and QOL ($P > .05$). However, intensity of treatment was a significant predictor of QOL (**Table 4**). Those who underwent surgery plus adjuvant treatment or chemoradiation reported decreased SF-20 health perceptions ($P = .047$), increased SF-20 pain ($P = .049$), and decreased UWQOL physical functioning ($P = .003$) compared to those who underwent radiation or surgery alone.

Insurance Type

Individuals who had Medicare/Medicaid insurance reported lower SF-20 mental health ($P = .01$) and UWQOL social/emotional scores ($P = .003$) compared to those who had private insurance or who were self-pay (**Table 4**). Of note, only 6 patients in the cohort composed the self-pay group, which limited the statistical power of this comparison.

Temporal Trends

An analysis of temporal data indicated a significant positive trend over time for SF-20 physical functioning (slope = 2.8, $P = .03$), role functioning (slope = 3.8, $P = .02$), and health perceptions (slope = 2.4, $P = .01$) subscales. With each pair of surveys completed over time, QOL increased by 2.8, 3.8, and 2.4 points in each of these domains, respectively.

Assessing Potential for Reporting Bias

There were no significant differences in the number of surveys completed over time for patients with differing sex, race, ethnicity, marital status, number of others in household, emotional or physical abuse, tobacco use, alcohol use, religious status, insurance type, tumor site, or stage ($P > .05$). The exception was treatment intensity ($P = .03$) (**Table 5**). Patients who underwent surgery plus additional treatment (median: 2, Min: 1, Max: 11) or surgery alone (median: 2, Min: 1, Max: 7) had significantly greater median numbers of surveys completed compared to those who underwent chemoradiation (median: 1, Min: 1, Max: 6).

Table 4. Associations Between Covariates and QOL Subscales

Clinical predictor ^a	Model-adjusted means and 95% confidence intervals									
	SF-20 QOL subscales					UWQOL subscales				
	Physical functioning	Role functioning	Social functioning	Mental health	Health perceptions	Pain	Physical	Social/emotional		
Race ^b										
White	61 (55-66) (NS)							65 (58-72) (NS)		
Non-white	44 (27-61) (NS)							44 (32-56) (NS)		
Ethnicity ^b										
Not Hispanic or Latino							75 (69-80) (NS)			
Hispanic or multiple							50 (30-69) (NS)			
Marital status										
Married	66 (56-76)	72 (64-80)	83 (77-89)	74 (67-82)	66 (59-73)	31 (21-41)		63 (54-71)		
Widowed	56 (40-72)	57 (40-74)	78 (65-91)	62 (52-72)	55 (43-66)	49 (34-63)		52 (42-63)		
Single	50 (38-62)	47 (34-59)	64 (55-73)	66 (58-74)	58 (49-67)	38 (27-49)		54 (45-63)		
Divorced	36 (22-50)	35 (22-49)	57 (46-67)	62 (54-70)	55 (46-65)	42 (31-54)		50 (41-59)		
Emotional or physical abuse										
No				75 (70-80)		27 (19-34)		64 (57-71)		
Yes				57 (47-68)		53 (38-68)		46 (35-57)		
Tobacco use										
Never					64 (55-72)	34 (22-45)	67 (56-79)	60 (51-69)		
Former					61 (53-69)	40 (29-51)	62 (50-73)	55 (46-64)		
Current					51 (43-59)	46 (35-56)	57 (46-69)	49 (41-58)		
Alcohol use										
Rarely/never						35 (25-45)				
Social						48 (37-58)				
Former						43 (30-56)				
Daily						35 (22-48)				
Religious status										
Not religious	57 (47-68)		76 (69-82)			34 (23-44)				
Religious	47 (37-57)		65 (59-71)			46 (36-56)				
Insurance status										
Private				69 (64-74)				57 (51-63)		
Medicare/Medicaid				61 (54-68)				48 (40-56)		
Self-pay				68 (54-83)				59 (44-75)		
Treatment										
Radiation					61 (38-83)	21 (-4 to 46)	68 (47-89)			
Surgery					66 (58-74)	42 (31-53)	69 (58-80)			
Chemoradiation					54 (48-61)	46 (37-55)	57 (47-67)			
Surgery+					53 (48-58)	50 (42-59)	54 (44-65)			

NS scores are listed when differences may be clinically significant but did not reach statistical significance. QOL scores were based on a scale of 0 to 100.

Abbreviations: NS, not statistically significant; QOL, quality of life; SF-20, 20-Item Short Form; UWQOL, University of Washington Quality of Life.

^aStatistically significant ($P < .05$) predictors of mean SF-20 and UWQOL subscale scores.

^bFor race and ethnicity, there were only 13 non-white and 6 Hispanic or Latino patients, therefore valid statistical analyses to prove the significance of these differences could not be performed.

Table 5. Comparison of Median Number of Surveys Completed According to Variables Collected

Variable	Kruskal-Wallis <i>P</i> value for comparison of the median number of surveys
Sex	.99
Race	.75
Ethnicity	.12
Marital status	.19
Number of others in the household	.76
Emotional or physical abuse	.96
Tobacco use	.19
Alcohol use	.29
Religious status	.93
Insurance type	.10
Primary tumor site	.05
Clinical disease stage	.60
Treatment	.03

Discussion

In this study, traveling greater distances for the treatment of HNC was not associated with differences in QOL. Rather, a variety of demographic, behavioral, oncologic, and treatment factors emerged as stronger predictors of QOL, favoring individuals who were married with no history of an abusive relationship, never smoked, did not have a documented religious affiliation, did not have Medicaid or Medicare insurance, and underwent a less intense treatment regimen. QOL also improved over the duration of subsequent clinic visits following surgery.

Due to the potential burden of travel (time, cost) on patients with HNC who may have physical limitations,¹⁷ we hypothesized that increased distance to the treatment center would negatively affect QOL. Conversely, previous research has identified an unexpected positive association between traveling further distances for HNC treatment and improved survival.^{2,3,8} Similar relationships might have been expected to exist between distance and QOL, however, our study found no such association.

In the current study, other patient-level factors were greater predictors of QOL. Marital status was significantly associated with 7 of the 8 possible QOL domains, making it the strongest predictor of QOL of all variables. There is evidence that perceived social support is strongly associated with QOL.^{18,19} Married patients have access to immediate social and emotional support that could have helped them cope with their cancer diagnosis and the burdens of treatment. Partners also likely provided tangible services and informal caregiving. Interestingly, having others living in the household did not have the same impact on QOL, highlighting the unique social, emotional, and physical support provided by a spouse. This may be replicated by dedicated patient navigators.

Our study is the first to report a significant decline in multiple QOL domains among patients who experienced emotional or physical abuse. Nearly 1 out of every 5 females in our study were affected, and the actual rate of abuse may be even higher. This underscores the importance of screening for intimate partner violence and patient safety concerns at clinic visits, as this is associated with significant health consequences that may compound the psychosocial challenges that accompany cancer and treatment.²⁰

A number of other factors were also associated with QOL, many of which were consistent with prior literature. Our study supports that racial and ethnic disparities in cancer care may contribute to the deterioration of QOL in non-whites and ethnic minorities.²¹ However, it should be noted that comparisons including non-white race and Hispanic ethnicity were limited by small sample sizes and therefore conclusions must be tempered. Additionally, our analysis is consistent with studies noting a negative association between tobacco use and QOL.²²⁻²⁴ Regarding insurance type, existing literature has suggested a positive relationship between private insurance and QOL compared to government or no insurance.²⁵ In our study, private insurance was also associated with improved QOL compared to Medicare/Medicaid. The self-pay insurance group was composed of only 6 patients, therefore meaningful conclusions could not be made regarding patients with this class of insurance. Uninsured individuals may have been underrepresented in our study as they are less likely to follow up.²⁶ Our finding that patients who underwent the most intense treatment regimens had the lowest QOL highlights that QOL should be considered in addition to prognosis when making informed treatment decisions.^{27,28} Extrapolating temporal trends in this study, patients realized clinically significant improvements in QOL after completing between 3 and 4 clinic visits following treatment. This was consistent with prior research, which has indicated a gradual improvement in QOL over time after initial treatment.^{9,29,30}

Aside from the benefits provided by the inevitable passage of time, social support and care coordination are modifiable, racial disparities can be addressed, and resources can be provided to counsel those in abusive relationships and encourage smoking cessation. Therefore, there is considerable potential for improvement in these areas.

Finally, it is unclear why patients with a religious affiliation reported lower QOL. This was surprising considering that patients may turn to faith to make sense of their diagnosis, help with coping, and as a source of hope.³¹ It should be noted that patients were categorized based on whether they identified with a religion in their medical record, which does not necessarily indicate their overall religiosity. Additional research is necessary to further explore this association.

Strengths of our study include the large number of variables analyzed, and reporting QOL at multiple time points using both a head and neck specific and general health survey. Our institution serves a wide catchment

area with varied socioeconomic statuses, therefore our results are likely generalizable to HNC patients receiving care at academic centers across the country. However, this study is not without limitations. One limitation is that our results are dependent on the accuracy of information documented in the medical record. In addition, pretreatment QOL values were not obtained, which is a significant limitation because it precluded the evaluation of the true change in QOL, and how much is driven by the cancer diagnosis, treatment, or various social metrics. However, these surveys were intentionally not administered before treatment since some of the questions can be sensitive if a patient does not yet know they have cancer or if they were just diagnosed. Participants also completed variable numbers of surveys at different time points throughout their disease course with an inconsistent amount of time between each. Disparities in survey responses and numbers per patient could create reporting bias in which patients with means who are doing well fill out more surveys over time, while those who are doing poorly may complete less surveys. However, our analysis showed that the number of surveys completed only varied according to treatment type. Further, patients with more invasive treatment, who would be expected to have lower QOL according to our study, actually completed more surveys. Because physical, emotional, and psychosocial challenges may vary based on when a patient is surveyed, this also represents a potential bias. However, the retrospective nature of this study makes it extremely difficult to standardize exact survey timing. Additionally, it is possible that some patients who lived greater distances from the treatment center may not have sought follow-up care and were not represented.

Patients in this study were treated at a single high-volume medical center, ensuring consistent treatment quality. The study suggests that factors other than physical access to care are more closely linked to QOL. The impact of facility volume or treatment quality on QOL cannot be determined from this data. Future multicenter studies should investigate the effects of treatment at academic versus community hospitals to determine if regionalization of care may improve QOL.

Conclusions

Travel distance does not affect QOL in patients with HNC. This does not parallel the previously reported positive association between distance and survival. QOL is more closely linked to marital status, abuse, tobacco use, religious affiliation, treatment intensity, and time following surgery. To improve the lives of patients with HNC, it is crucial to focus on support structure, lifestyle, and socioeconomic factors.

Author Contributions

F. Jeffrey Lorenz, concept design, data collection, reviewing data analysis, writing the manuscript, presentation; **Tonya S.**


King, statistical methods, data analysis, final approval of the manuscript; **Linda Engle**, statistical methods, data analysis, final approval of the manuscript; **Francis Beauchamp-Perez**, critical editing of the manuscript, final approval of the manuscript; **Neerav Goyal**, concept design, reviewing data analyses, critical editing of the manuscript and final approval.


Disclosures

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