Health-related Quality of Life in Head and Neck Cancer Survivors: Evaluating the Rural Disadvantage

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Abstract

Purpose: Head and neck cancer (HNC) survivors often experience distress and health-related quality of life (HRQOL) impairment. Research suggests rural cancer patients may have poorer outcomes than urban patients. This study examined whether HNC patient emotional and HRQOL outcomes differ in those living in a rural vs. urban location at 6 and 12 months post-diagnosis.

Methods: A total of 261 HNC patients were included from a longitudinal study of HNC outcomes. The majority were diagnosed with advanced stage cancer (51.3%); the most common cancer site was oral cavity (41.0%). Rurality was measured using US Department of Agriculture Rural Urban Commuting Area codes. Depression was measured using the Beck Depression

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Inventory (BDI), general HRQOL using the Short Form-36 (SF-36), and HNC-specific HRQOL using the Head and Neck Cancer Inventory (HNCI). Analyses were 2 (group) × 3 (assessment) repeated measures ANCOVAs, controlling for demographic and clinical characteristics.

Findings: Approximately 45% of the sample lived in a rural location. Follow-up comparisons of significant overall models indicated that rural patients reported significantly more non-somatic depression symptoms at 6-month follow-up. Rural patients were also more likely to report significantly poorer general mental HRQOL at 12-month follow-up, significantly poorer HNC-specific HRQOL related to eating at 6- and 12-month follow-up, and marginally worse aesthetics at 12-month follow-up.

Conclusions: These findings are consistent with suggestions that rural HNC patients may be at heightened risk for depression symptoms and decrements in HRQOL. Patients should be screened and regularly monitored for issues with depression and HNC-specific HRQOL throughout the survivorship period.

Keywords

Approximately 53,000 Americans develop head and neck cancer (HNC) annually,[1] which is defined as cancer of the oral cavity, pharynx (nasopharynx, oropharynx, hypopharynx), larynx, nasal cavity, paranasal sinus, and/or salivary glands. The most common treatments for HNC are surgery, radiation, and chemotherapy, which can be used alone or in combination.[2] The side effects of treatment can include difficulties with swallowing, breathing, eating and speech, and can lead to disruption of multiple life activities and facial disfigurement.[3] HNC is a uniquely intrusive disease given both its significant visibility and its potential to disrupt basic functions. This intrusiveness coupled with societal pressures placed on physical appearance may make HNC particularly emotionally traumatic.[4] Moreover, common risk factors associated with HNC are often related to stigmatized negative health behaviors, such as tobacco and alcohol use, and risky sexual behaviors which may result in acquisition of human papillomavirus (HPV), a sexually transmitted infection.[5] These risk factors further add to HNC patients' traumatic cancer experience because of feared or actual judgement from others.[6]

Not surprisingly, patients with HNC often experience depressive symptoms and deficits in health-related quality of life (HRQOL) during and after recovery.[3,6] According to a recent review, the prevalence of depression ranged from 4% to 42% in HNC patients.[7] One national study found the incidence of a depressive disorder in HNC patients was 9%, with the highest prevalence being among those diagnosed with larynx cancer (31%).[8] Others have found an incidence rate of major depressive disorder in this population between 15% and 50%.[9] A longitudinal study found that 29%–42% of HNC patients experienced clinically meaningful levels of depression symptoms (as measured by the Center for Epidemiologic Studies-Depression scale) from the start of treatment to 6 months posttreatment.[10] The trajectory of depression has also been shown to change over the course of treatment. For example, a prospective study that measured depression using the Hospital Anxiety and Depression Scale found that at baseline, 15% of HNC patients reported elevated depression,

but by 3 weeks posttreatment the incidence level rose to 29%.[11] HNC has also been found to be one of the top cancers associated with risk for suicide,[12,13] with a suicide rate 4 times higher than the general population.[14] About 9% of HNC patients in a longitudinal study reported having suicidal ideations and over 50% of those patients were diagnosed with depression.[15] HNC survivors have been shown to be almost 2 times more likely than survivors of other cancers to die from suicide.[16] Moreover, depression has been shown to predict early mortality in HNC patients.[17–19]

In addition to significant psychological distress, HNC patients also experience substantial functional impairments that reduce their HRQOL. For many HNC patients, HRQOL deteriorates significantly during treatment and then slowly recovers. However, a considerable number of HNC patients do not regain their pre-treatment functioning,[20] meaning they must learn to live with the effects of their treatment as their new normal. HNC patients commonly experience persistent symptoms like dry mouth, difficulties with senses such as smell and taste, and dental issues.[21] In fact, a study examining the long-term HRQOL in HNC survivors found that 50% of patients reported difficulties eating and 17% reported substantial pain at a 5-year follow-up.[22]

HNC Outcomes and the "Rural Disadvantage"

Taken together, HNC patients experience many impairments across different domains, and there is reason to believe that outcomes are worse among rural cancer patients both in terms of prevalence of the condition and outcomes of survivors.[23,24] The incidence rates for HNC and the rate of death among all HNC patients have both declined somewhat in recent years.[16,25] Yet, in a SEER database study, the incidence of oropharynx cancer was shown to be increasing faster in rural areas, while the rates of larynx and oral cavity cancers were decreasing more rapidly in urban areas.[26]

Past reports have also found rural-urban disparities among cancer survivors on HRQOL outcomes and cancer deaths.[23,27,28] Living in a rural area has been associated with poorer physical and psychological outcomes in survivors of breast, gynecologic, prostate, colorectal, lung, melanoma, and hematologic cancers.[23,29] For example, rural survivors were more likely to report psychological and physical distress, health-related unemployment, and activity limitations. Cancer patients living in rural areas were more likely to report only fair-to-poor health compared to their urban counterparts; they were also more likely to have 2 or more non-cancer comorbidities and have less access to health insurance and health care.[24] In a recent systematic review of rural-urban residence and cancer survival in high-income countries, Afshar and colleagues found that most studies report worse survival for cancer patients living in rural areas.[30] High mortality rates have also been observed for oropharyngeal cancers in rural areas.[31] Hence, living in a rural area seems to be associated with worse outcomes for cancer patients. However, little work has been done to examine the association of rural-urban disparities in HNC patient HRQOL outcomes specifically.

Some work in chronic disease populations has suggested that the presence of factors that negatively impact HRQOL and disease management may explain why patients in rural settings face a so-called "rural disadvantage."[32–34] Such factors include greater travel burden

for cancer care and continued cancer surveillance. These factors have been shown to be associated with poorer survival rates and HRQOL for rural patients compared to their urban counterparts given their limited access to health care resources.[35] In a sample of HNC patients from Australia, researchers found that rural patients were more likely to have delays from diagnosis to first treatment.[36] Other factors that may also explain this disadvantage are reduced access to technology, reduced social support, and/or limitations in other psychosocial resources, but it is unclear to what extent.

Much of the research to date has focused on survival disparities; while such investigations are critical, equally important are investigations into whether survivors differ on psychosocial outcomes following treatment.[37,38] In fact, little research has explicitly compared rural and urban HNC survivors on measures of depression or HRQOL. Better understanding of unique challenges or increased morbidity among HNC survivors living in rural settings is critical for appropriate risk stratification and management of patients, particularly as the relative incidence of HNC remains high. Thus, the present exploratory study examined whether HNC patients living in rural areas have worse depressive symptoms and poorer general and HNC-specific HRQOL outcomes 6 and 12 months after their cancer diagnosis, representing an important period of the survivorship trajectory, compared to patients living in urban locations.

Materials and Methods

Participants and Procedure

The present study examines data from a longitudinal study of HNC oncologic treatment outcomes conducted at an academic medical center in Iowa, a state in the Midwestern region of the United States.[39,40] The study procedures were approved by the university's institutional review board. Included patients were adults aged 18+ who were diagnosed with upper aerodigestive tract carcinomas (larynx, hypopharynx, oropharynx, lip, and oral cavity) from the University of Iowa's Department of Otolaryngology's head and neck oncology clinic. In brief, patients were recruited during an initial clinic visit to an ongoing longitudinal study, the Outcomes Assessment Project (OAP). Primary or recurrent cases were considered eligible for this study, regardless of stage. Upon obtaining consent, patient clinical and psychosocial characteristics were assessed near the time of diagnosis (pretreatment), and at 3-, 6-, 9-, and 12-month follow-up. The enrollment duration of the parent study took place between February 1998 and October 2013; approximately 76% of eligible patients enrolled. The present study includes patients with complete data on the primary outcome measure (depressive symptoms) at time of diagnosis, and the 6- and 12-month follow-up assessments. Chi-square and independent samples t-tests were conducted to compare patients with complete depressive symptom data (ie, at baseline, 6-month, and 12-month follow-up) and those without for the present secondary analyses ($n = 261$ and $n = 238$, respectively). The groups did not differ significantly in terms of age, sex, cancer site, cancer stage, treatment type, alcohol use at time of diagnosis, or depressive symptoms. Significant group differences were found for smoking status at diagnosis (chi-square [1] $= 7.27$, $P = .007$). Among patients who met inclusion criteria for the present analyses,

significantly more than expected reported at baseline as not currently smoking (z = 2.70, *P* = .007).

Measures

Rurality—Rurality was measured using the US Department of Agriculture's Rural Urban Commuting Area (RUCA) codes.[41] RUCA utilizes a 10-point scale and includes primary commuting flow and secondary commuting flow scores, based on the 2010 census data. RUCA codes were then dichotomized to either a rural or urban location, based on the recommendations of the University of Washington's Rural Health Research Center 2-category classification system.[42]

Beck Depression Inventory—Depressive symptoms were measured by the Beck Depression Inventory (BDI), a 21-item questionnaire that is widely used and well-validated.[43,44] Given the overlap between depressive symptoms and the somatic symptoms experienced during HNC (eg, change in appetite, weight, and fatigue), the 14 non-somatic items of the BDI were totaled and examined separately and served as the primary depression outcome measure. This approach has been previously used with HNC populations.[45]

Medical Outcomes Study Short Form 36—The Medical Outcome Study Form 36 (SF-36),[46] a widely used measure for general health assessment, was used to assess general HRQOL.[47,48] It includes 2 composite summary scores, 1 for mental and 1 for physical functioning domains. A norm-based algorithm to score the SF-36 was used to compute these composite scores.[49] Scores range from 0 to 100, with higher scores representing better general HRQOL.

Head and Neck Cancer Inventory—Head and neck cancer-specific HRQOL was measured using the Head and Neck Cancer Inventory (HNCI),[50] a validated 30-item instrument that was developed to assess aspects of HRQOL in HNC patients that are not captured by general HRQOL measures. The 4 domains measured include speech, aesthetics, social disruption, and eating. Speech items examine problems with talking, being understood, and hoarseness (eg, "*Have you had problems talking at home?* and "*How often have others had problems understanding you because of the way you talk?*"). Aesthetics items examine attitudes towards appearance (eg, "*Have you felt self-conscious about the way you look?*"). Social disruption items examine how the illness has affected social functioning (eg, "*Has this illness changed your sexual activity?*" and "*Have you avoided being with friends because of pain or discomfort resulting from this illness?*"). Finally, eating items examine difficulties with swallowing, chewing, or teeth (eg, "*Have you had to restrict the foods you can eat?*" and "*Have you been bothered by a change in your teeth or dentures?*"). Scores of the four domains range from 0 to 100, with higher scores indicating better HRQOL. The HNCI has been commonly used in HNC populations.[45,51,52]

Analytic Strategy

Descriptive statistics were computed, and clinical characteristics were compared between rural and urban patients using chi-square tests of independence for categorical variables and t-tests for continuous variables. A series of 2 (group: rural vs. urban) × 3 (assessment

period: baseline/pre-treatment vs. 6-month follow-up vs. 12-month follow-up) repeated measure analyses of covariance (ANCOVAs) were conducted to assess rural-urban group differences in depression and across several HRQOL domains. Control variables in our models included: age, sex, cancer site, cancer stage, and tobacco use. Cohen's *d* effect sizes were also calculated. Results were considered statistically significant if *P* < .05.

Results

Study Sample

Two hundred and sixty-one HNC patients were included in this study. Table 1 summarizes the demographic and clinical characteristics of the study cohort based on urban/rural location. The mean age was 59.9 years (SD =12.3; range 25–89), and 60.2% of the sample were men. Most patients identified as White, Non-Hispanic (93.1%). The majority of patients (51.3%) were diagnosed with advanced stage (3 or 4) cancer and the most common cancer sites were oral cavity (41.0%), followed by oropharynx (21.5%) and larynx (18.8%). These characteristics are similar to general US HNC statistics.[53,54] Regarding treatment, most patients (46.0%) received a multimodal approach (a combination of surgery, radiation, or chemotherapy) compared to a single modality (45.2%), and 69.7% of patients had a surgical component to their treatment. At the time of enrollment (ie, time of diagnosis), 43.7% reported currently using alcohol, and 20.3% reported current tobacco use. Of the included patients, 45.2% lived in a rural location. Concerning baseline and clinical characteristics, an independent samples *t*-test was conducted to compare the age of the rural and urban patients. There was no significant difference on this variable between groups (*P* = .766). Chi-square tests of independence were calculated to compare the gender, race, ethnicity, cancer stage, cancer site, treatment, tobacco status, and alcohol status between rural and urban patients. There was no significant difference between groups on these variables, with the exception of smoking status, χ^2 (1, N = 245) = 4.16, *P* = .041, with rural patients more likely to report as currently smoking. Further, sensitivity analyses demonstrated no differences on any outcome of interest by date of enrollment.

Primary Outcome Measure – Patient Depression Symptoms

Descriptive statistics for the primary and secondary outcome variables and results of the repeated measures ANCOVAs can be found in Table 2. For the non-somatic depressive symptom scores, there was a main effect for group (*F*(1, 232) = 4.07, *P* = .045), indicating greater depressive symptoms among rural patients. Comparison of non-somatic depression scores at each time point revealed that rural patients reported significantly more symptoms at the 6-month follow-up compared to urban patients (rural M(SD) = 4.40 (5.89) vs. urban M(SD) = 2.65 (3.42), *t* = −2.26, *P* = .025), but not at the 12-month follow-up. The effect sizes for these comparisons were small (baseline Cohen's *d* = .22; 6-month Cohen's *d* = .36; 12-month Cohen's *d* = .27). Regarding total BDI, there was no main effect for group (*F*(1, 232) = 2.30, *P* = .131).

Secondary Outcome Measures – Health-Related Quality of Life (HRQOL)

For general HRQOL, there was a significant main effect for group when examining mental functioning, (*F*(1, 189) = 3.94, *P* = .048), with rural patients reporting greater impairment

at the 12-month follow-up (rural M(SD) = 49.19 (10.97) vs. urban M(SD) = 52.61 (8.57), t = 2.06, P = .041). The effect sizes for these comparisons were small (baseline Cohen's d = .22, 6-month Cohen's d = .31, 12-month Cohen's d = .35). There was no main effect for group when examining physical functioning ($F(1, 189)$ = .24, P = .624). When examining HNC-specific HRQOL domains, there was no main effect for group with regard to speech ($F(1, 194)$ = 2.57, P = .110) or social disruption ($F(1, 208)$ = .46, P = .497). For eating, there was a significant main effect for group ($F(1, 192)$ = 4.98, P = .027), with rural patients reporting worse HNC-specific HRQOL than urban patients at the 6-month (rural M(SD) = 50.10 (26.16) vs. urban M(SD) = 60.59 (27.60), t = 2.45, P = .015) and 12-month follow-up (rural M(SD) = 57.78 (26.12) vs. urban M(SD) = 67.08 (26.38), t = 2.18, P = .031). The effect sizes were small to moderate for these comparisons (baseline Cohen's d = .09; 6-month Cohen's d = .39; 12-month Cohen's d = .35). There was also a significant main effect for group with regard to aesthetics, ($F(1, 204)$ = 4.78, P = .030), with rural patients reporting marginally worse HNC-specific HRQOL than urban patients at the 12-month follow-up (rural M(SD) = 72.27 (29.61) vs. urban M(SD) = 83.87 (24.40), t = 1.95, P = .052). The effect sizes were small for these comparisons (baseline Cohen's d = .26; 6-month Cohen's d = .24; 12-month Cohen's d = .32).

Lastly, we examined whether the rurality effect was moderated by patient gender for the domains with a statistically significant difference (ie, non-somatic depression, mental functioning, eating, and aesthetics.) The rurality by gender interaction was only significant for the domain of eating ($F(1, 191)$ = 4.83, P = .029). Comparison of eating HRQOL scores at each time point revealed that urban female HNC patients reported less impairment at 6 months compared to urban males (male M(SD) = 58.34 (29.46) vs. female M(SD) = 63.67 (24.81)), while rural female HNC patients reported greater impairment compared to rural males (male M(SD) = 54.09 (25.65) vs. female M(SD) = 43.83 (26.07)). A similar pattern was seen at the 12-month follow-up, with urban females reporting less impairment than urban males (male M(SD) = 64.25 (28.73) vs. female M(SD) = 70.96 (22.52)), while rural female patients reported greater impairment compared to rural males (male M(SD) = 62.16 (26.63) vs. female M(SD) = 50.90 (24.08)). This pattern suggests that within the eating domain of HRQOL, living in a rural setting seems to be associated with greater impairment for female survivors.

Discussion

This exploratory study examined whether 6- and 12-month psychosocial and HRQOL outcomes differed in HNC patients living in rural versus urban locations. HNC patients who live in rural locations experienced more non-somatic depression symptoms than their urban counterparts 6 months following their cancer diagnosis. This difference was no longer significant at 12 months following diagnosis, however. This may be related to the relatively low levels of depression reported by both groups in the current study. These findings are also consistent with previous research that has found HRQOL to decline immediately following treatment and generally recover to baseline levels within the first year in many patients.[21,55] There was also a significant difference between rural and urban patients on a general HRQOL measure of overall mental functioning, with rural patients experiencing poorer functioning. This may be related to the difference seen in non-somatic depression, as mental

functioning on the SF-36 is also an indirect indicator of depressive symptoms.[46,56,57] Rural patients were also more likely to report poorer HNC-specific HRQOL related to eating at the 6- and 12-month follow-up, and marginally worse aesthetics at the 12-month follow-up. The eating domain of the HNCI assessed problems chewing foods, changes in teeth, mouth dryness, and difficulties swallowing while the aesthetics domain examined whether patients were bothered and/or self-conscious about their appearance. Further study of rural-urban differences in HNC-specific HRQOL should be considered in light of these results.

There were no significant differences between groups on measures of total depression, which included somatic symptoms often experienced by HNC patients, such as fatigue, loss of appetite, and changes in weight. Interestingly, differences between groups were not consistent across HRQOL domains. Specifically, rural and urban patients did not differ on general HRQOL measures regarding global physical functioning, or HNC-specific domains of social disruption or speech. This may be reflective of the severity of the disease, as there are many intrusive physical issues that arise following cancer treatment that likely affect all HNC patients, regardless of their geographic location.[3]

Though the current study did not examine health care utilization between rural and urban patients, other reports have found that rural cancer patients are less likely to have access to health insurance and health care.[24] Perhaps limited access to general medical care, cancer surveillance, and/or functional and cosmetic reconstructive surgeries are related to the differences reported in the eating and aesthetics HRQOL domains. Furthermore, it is possible that limited access to psychosocial services may impact ability to cope with difficulties in eating and/or aesthetics, and thus, partially fostering poorer quality of life in these domains. Indeed, rural patients have been found to have less access to mental health services and be more wary of mental health interventions.[58] Rural locations have pronounced shortages of mental health care professionals,[59] and due to the stigma and decreased anonymity of receiving psychological services in a small rural area, acceptability of services may be reduced.[60] Rural patients may also have less access to dietetic services as well.[61]

Gender differences may also play a role in psychosocial adjustment for HNC survivors. In the current sample, women who lived in a rural location reported significantly more impairment on the eating domain at the 12-month follow-up. This finding suggests that rural women may experience significant impairment with eating by the end of the first year of HNC treatment, which includes restrictions of foods consumed and problems with teeth and dentures and deserves further study. Relatedly, previous research has found women with HNC to be more likely to demonstrate higher levels of depression than their male counterparts.[62] A recent study on the role of urban/rural location and stigma around mental illness also found that women residing in rural areas held higher levels of stigma towards mental illness.[63] Thus, female HNC patients residing in rural locations may be more likely to experience, and face difficulty seeking out services for, certain aspects of well-being or functioning.

Clinical Implications

These findings suggest the need for depression screening, referral, and management for rural HNC patients, particularly during the initial months following diagnosis when the patient is undergoing/completing treatment. Given that previous longitudinal studies have found that most HNC patients reporting suicidal ideations also have a depression diagnosis,[15] the months following HNC treatment may be a particularly important time for providers to monitor rural patients' psychological functioning. HRQOL has also been demonstrated to be lowest during the period around treatment and may represent a particularly vulnerable time with respect to mental health.[21] The present findings are consistent with previous research assessing rural-urban differences in other cancers, in which rural cancer survivors have higher symptoms of depression and distress compared to urban survivors.[64] These differences suggest that depression screening at the beginning of HNC treatment may allow providers to assess changes in depressive symptoms and intervene, if necessary, by referring patients to mental health services.

Further, health care providers may consider talking with rural HNC patients before treatment about the possibility of increasing depressive symptoms, particularly over the initial months of treatment. Providing patients and their families with psychoeducation around the symptoms associated with depression (eg, anhedonia, suicidal ideations, hopelessness) may help patients and family members identify these experiences and seek treatment. Talking about these experiences early on may also encourage patient to discuss such symptoms with providers later. Finally, given mental health services may not be as accessible in rural settings, helping patients find psychological care with providers who offer telehealth visits at the beginning of treatment may help establish such services before the patient is experiencing an increase in depressive symptoms. Discussing this with the patient early in treatment may also allow health care providers to coordinate with mental health professionals within their own medical center, maximizing the patient's visit when they do travel for clinical appointments and improving care coordination.

Limitations

There are several limitations of the current study that warrant consideration. This study reports on secondary analyses of data from a longitudinal study of HNC outcomes. Only patients with complete data on the primary outcome measure (BDI depression) were included; therefore, missing data exist in the secondary outcome measure analyses. Thus, the generalizability of the results should be considered. This study also relies on a self-report assessment of depression symptoms. Lifetime history of depression diagnosis and whether a patient received depression management during cancer treatment was not assessed. Additionally, our study sample was predominately White and limited to one region of the United States. Though consistent demographically with this region's population, the sample and the findings may not generalize to other regions. However, our study sample is comparable to national HNC norms in terms of sex, age, and stage.[53,54] Finally, while we controlled for several potential confounding variables (age, sex, cancer site, cancer stage, and tobacco use), it is possible that other variables may be contributing to differences in HRQOL between the rural/urban groups. For example, our study did not include information on participants' socioeconomic status, income, or years of education.

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Conclusion

In conclusion, the present study indicated that rural HNC patients specifically experienced more non-somatic depression symptoms than their urban counterparts 6 months following diagnosis. Rural patients were also more likely to report poorer HNC-specific HRQOL regarding eating at 6 and 12 months post-diagnosis, and marginally worse aesthetics 12 months post-diagnosis. These findings are consistent with a growing body of literature suggesting the need for brief depression screening among HNC patients and for the development of protocols for managing patient distress and depression, particularly among patients residing in rural locations who may have limited access to mental health services. More research is needed to discern whether there are elements of HRQOL and emotional well-being that are particularly vulnerable across the survivorship course in rural HNC patients.

Funding:

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Table 1.

Demographic and clinical characteristics of rural and urban head and neck cancer survivors at the time of diagnosis

	All N = 261	Urban N = 143 (54.8%)	Rural N = 118 (45.2%)	*P*
Age				.766
Mean (SD)	59.9 (12.3)	59.7 (12.7)	60.1 (11.9)	
Sex, No. (%)				.996
Male	157 (60.2%)	86 (60.1%)	71 (60.2%)	
Race, No. (%)				.688
White	243 (93.1%)	131 (91.6%)	112 (94.9%)	
African American	4 (1.5%)	3 (2.1%)	1 (.8%)	
Other	6 (2.3%)	3 (2.1%)	3 (2.5%)	
Unknown	8 (3.1%)	6 (4.2%)	2 (1.7%)	
Ethnicity, No. (%)				
Hispanic	4 (1.5%)	2 (1.4%)	2 (1.7%)	.966
Stage, No. (%)				.469
Early (0–2)	103 (39.5%)	60 (42.0%)	43 (36.4%)	
Advanced (3–4)	134 (51.3%)	67 (46.8%)	67 (56.8%)	
Not stageable/unknown	24 (9.2%)	16 (11.2%)	8 (6.8%)	
Site, No. (%)				.058
Oral cavity	107 (41.0%)	64 (44.7%)	43 (36.4%)	
Oropharynx	56 (21.5%)	36 (25.2%)	20 (16.9%)	
Hypopharynx	10 (3.8%)	4 (2.8%)	6 (5.1%)	
Larynx	49 (18.8%)	19 (13.3%)	30 (25.4%)	
Else/unknown	39 (14.9)	20 (14.0%)	19 (16.1%)	
Treatment, No. (%)				.638
Surgery	182 (69.7%)	101 (70.6%)	81 (68.6%)	
Non-surgical	56 (21.5%)	28 (19.6%)	28 (23.7%)	
None/unknown	23 (8.8%)	14 (9.8%)	9 (7.6%)	
Tobacco status, No. (%)				.041
Currently using	53 (20.3%)	22 (15.4%)	31 (26.3%)	
Not currently using	192 (73.6%)	110 (76.9%)	82 (69.5%)	
Unknown	16 (6.1%)	11 (7.7%)	5 (4.2%)	
Alcohol status, No. (%)				.170
Currently using	114 (43.7%)	67 (46.8%)	47 (39.8%)	
Not currently using	130 (49.8%)	65 (45.4%)	65 (55.1%)	
Unknown	17 (6.5%)	11 (7.7%)	6 (5.1%)	

Note: independent samples *t*-test was conducted to compare the age of rural vs. urban patients. Chi-square tests of independence were calculated to compare gender, race, ethnicity, cancer stage, cancer, site, treatment, tobacco status and alcohol status.

Table 2.

Repeated measures analysis of covariance tests of between-subjects effects for rural vs. urban HNC patients on primary and secondary outcome variables

	Baseline		6-month follow-up		12-month follow-up				
	Urban	Rural	Urban	Rural	Urban	Rural	F	df 1, df2	P
BDI, M (SD)									
Total	7.11 (5.17)	8.14 (7.79)	7.10 (6.16)	9.51 (8.66)	6.43 (6.58)	8.16 (8.24)	2.30	1, 232	.131
Non-somatic	2.77 (3.05)	3.72 (5.19)	2.65 (3.42)	4.40 (5.89)	2.62 (4.21)	3.88 (5.11)	4.07	1, 232	.045 [*]
SF-36, M (SD)									
Mental	48.38 (10.50)	45.94 (11.97)	49.75 (9.68)	46.34 (11.98)	52.61 (8.57)	49.19 (10.97)	3.94	1, 189	.048 [+]
Physical	50.10 (9.72)	48.52 (9.90)	47.41 (9.74)	46.39 (9.01)	48.13 (10.97)	47.30 (10.46)	.24	1, 189	.624
HNCI, M (SD)									
Speech	82.08 (20.06)	75.69 (21.12)	75.59 (19.68)	69.43 (22.46)	77.69 (21.15)	74.89 (21.76)	2.57	1, 194	.110
Aesthetics	93.80 (14.18)	89.36 (19.65)	80.34 (27.04)	73.40 (30.36)	83.87 (24.40)	72.27 (29.61)	4.78	1, 204	.030
Social Disruption	88.10 (15.75)	83.93 (17.57)	81.54 (20.17)	80.35 (21.66)	86.34 (19.34)	83.63 (19.70)	.46	1, 208	.497
Eating	78.20 (20.99)	76.07 (23.25)	60.59 (27.60)	50.10 (26.16)	67.08 (26.38)	57.78 (26.12)	4.98	1, 192	.027 [*+]

Note: BDI = Beck Depression Inventory; SF-36 = Medical Outcome Survey Short Form 36; HNCI = Head and Neck Cancer Inventory

[*] groups significantly differed at 6-month follow-up post hoc comparison;

[+] groups significantly differed at 12-month follow-up post hoc comparison

Models controlled for age, sex, cancer site, cancer stage, and tobacco use