

ORIGINAL RESEARCH

The impact of distance traveled and rurality on the clinical course of head and neck cancer

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Abstract

Objective: To explore the relationship between distance traveled and rurality to clinical timepoints and 2-year disease free survival (DFS) in newly diagnosed HNC patients.

Methods: This study was conducted through retrospective analysis, with key independent variables including distance to academic medical center and rurality score. To better understand delays in care, the sample was divided into two groups based on an optimal treatment timeline. We then assessed for the impact of distance traveled.

Results: A higher proportion of patients in the optimal treatment timeline group resided in metropolitan areas, which also had a lower mean index of medically underserved score. Patients in this group had a shorter duration from first presentation for HNC to presentation to an academic medical center and a shorter duration from referral to presentation. However, there was no significant difference in 2-year DFS between the groups. Those who lived closest to Upstate were more likely to identify as Black. Those who live in suburban communities around Upstate were most likely to initiate treatment within 1 month of presentation. Those who live farthest from Upstate were the least likely to have an HPV-negative cancer of the head and neck, and more likely to receive surgery as part of treatment and to receive a biopsy prior to presenting to Upstate.

Conclusions: Despite differences in distance traveled and rurality between communities, there was no impact on 2-year DFS. Together, we suggest that these findings support that socioeconomic and patient factors, instead of travel distance alone, impact HNC workup patterns.

Level of Evidence: Level III.

KEYWORDS

head and neck cancer, rurality, travel

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1 | INTRODUCTION

Over 65,000 people are diagnosed with head and neck cancer (HNC) each year in the United States, accounting for 3% of all malignancies in the country.^{1,2} Despite a downward trend in the overall prevalence of HNC in the United States, studies have found an increasing incidence of late-stage HNC.³ As stage at diagnosis carries immense implications for prognosis, it becomes imperative that diagnostic delays are minimized in order to optimize oncologic outcomes.^{1,4} Additionally, several studies have shown that shorter diagnosis to treatment intervals (DTI) correspond with improved survival, and locoregional control.⁴ The culmination of these findings emphasizes the importance of timely diagnosis and treatment for patients with HNC.

Distance traveled for treatment has historically been considered a barrier to oncologic care, but recent studies have demonstrated a survival benefit in patients traveling long distances, a trend thought to be secondary to the regionalization of care to large academic facilities.^{5,6} When applied to HNC patients, the impact of travel distance on survival has revealed variable results.^{5,7-9} Nonetheless, long travel times remain burdensome to patients and their families, and have an effect on initial staging, treatment decisions, and follow-up.^{5,10}

The region surrounding our institution includes rural, suburban and urban communities, with the rural populations located farthest from the medical center. Rurality is associated with higher rates of cancers related to modifiable risk factors such as HPV and smoking.¹¹ These factors are highly associated with the development of HNC; thus, patients from rural geography may be at increased risk for developing cancers of the head and neck. For these reasons, demographic variables should be considered in the analysis of potential disparities, particularly for patient's traveling farther distances for HNC care.

In this study, we aim to evaluate the relationship between distance traveled and rurality to work up patterns and 2-year disease free survival (DFS) in newly diagnosed HNC patients. This investigation was especially valuable for our medical center given the heterogeneity of our catchment area.

2 | METHODS AND MATERIALS

Data for patients evaluated for HNC at Upstate Medical University from 2015 to 2019 were obtained from the Upstate Cancer Center Registry for retrospective review. This study was deemed exempt from IRB review by SUNY Upstate Institutional Review Board for the protection of human subjects under category 4(iii) with limited dataset, [project # 1782388-1].

First, to better understand delays in care, we divided the sample into two groups based on an optimal treatment timeline. The optimal timeline was defined as biopsy proven HNC and imaging within 3 weeks of presentation to Upstate, and treatment within 90 days of presentation to Upstate. Patients with treatment timelines that fell within these parameters were included as the reference group and the remaining patients as the outlier group. We then conducted a second analysis to assess for the impact of distance traveled on treatment timelines and 2-year DFS.

Several covariates were analyzed to better understand the patients within this sample. Latitude and longitude of patient residences were ascertained using zip codes included in the medical record. The latitude and longitude points of the patient residences and the Upstate Cancer Center were then used to determine the distance in miles. Patients were then divided into one of four categories based on the distance of their primary residence from the Upstate Cancer Center: ≤ 3 , 3.1–12, 12.1–48, >48 miles. These categories were created in congruence with the organization of Central New York, with regards to rurality and indices of medical underservice areas.

We defined 2-year DFS as absence of disease recurrence, metastasis, or mortality 2 years after the completion of definitive treatment. Patients without data at the 2-year point were coded as lost to follow up. Patient residences were defined as metropolitan or nonmetropolitan at the level of the county using the rural-urban continuum defined by the National Cancer Institute's Surveillance, Epidemiology, and End Results Program. Metropolitan areas include codes 1 through 3, while nonmetropolitan areas include codes 4 through 6. Patient racial identity was ascertained through the medical record system and included in analysis as either White, Black, or Other. Patient insurance status at the time of diagnosis included none, Medicaid, Medicare, Private, or Other. Examples of other insurance included those insured through the Department of Veteran Affairs or through membership to an indigenous group. Sex was defined as male or female. Smoking status at the time of diagnosis was defined as never, former, or current. HPV status was defined as negative, positive, or unknown in cases where patients had no formal immunohistological staining performed. Stage at a diagnosis ranged from stage 1 to 4. Other categorical covariates included treatment within 1 month of presentation to Upstate, surgical intervention as part of care, and biopsy prior to presentation to Upstate. We also included the index of medical underservice. This index developed by the US Department for Health and Human Services ranges from 0 to 100, with 0 indicating the most underserved. Continuous covariates included age at diagnosis, percent college degree at the level of the county, and median household income at the level of the zip code. Time from first seen ever for HNC to time seen at Upstate, time from first seen to time of referral, time from referral to presentation to Upstate, time from presentation to Upstate to biopsy, time from presentation to Upstate to imaging, and time from presentation to Upstate to treatment were included in the absolute unit of days.

Statistical analyses were conducted using IBM SPSS Statistics version 27.0. Bivariate tests performed included chi-square, independent samples *t* tests, and one-way ANOVA testing. Post hoc tests were conducted when appropriate.

3 | RESULTS

From 2015 to 2019, 544 patients were seen at Upstate Medical University for a diagnosis of HNC. Of these patients, 35 were excluded from this study. Exclusion criteria included out of state residence

TABLE 1 Sample characteristics.

	Frequency	Percent
Distance		
Less than 3.0 miles	99	19.1
3.1–12 miles	120	23.2
12.1–48 miles	199	38.5
Greater than 48.1 miles	91	17.6
Rural–Urban Continuum Code		
1	3	0.6
2	427	82.6
3	24	4.6
4	38	7.4
6	17	3.3
Race		
White	476	92.1
Black	18	3.5
Other	15	2.9
Insurance		
None	9	1.7
Medicaid	90	17.4
Medicare	249	48.2
Private	131	25.3
Other	29	5.6
Sex		
Male	377	72.9
Female	132	25.5
Smoking history		
Never	100	19.3
Former	176	34.0
Current	231	44.7
HPV status		
Negative	309	59.8
Positive	106	20.5
Unknown	93	18.0
Stage at diagnosis		
1	113	21.9
2	180	34.8
3	90	17.4
4	110	21.3
Surgery		
No	269	52.0
Yes	240	46.4
	Mean	SD
Index of Medically Underservice Score	55.7	2.4
Age	64.0	11.6
First seen to Upstate ^a	43.9	58.6
Referral to Upstate ^a	19.0	39.6
Upstate to Biopsy ^a	–7.4	37.4

(Continues)

TABLE 1 (Continued)

	Frequency	Percent
Upstate to Imaging ^a	11.0	41.8
Upstate to Treatment ^a	44.0	44.3
Percent College Degree ^b	29.8	6.8
Median Household Income ^c	59,206	17,505

^aReported in days, where negative values indicate occurrence before presentation.

^bReported at the level of the county.

^cReported at the level of the zip code, unit is dollars.

($n = 6$) and incarceration at time of diagnosis ($n = 6$). For patients who presented with multiple independent cancers of the head and neck ($n = 24$), only their initial presentation was included in this analysis. Ultimately, 509 patients were included in this analysis (Table 1).

Within this sample, 19.4% of patients resided within 3 miles from Upstate, 23.6% of patients resided 3.1–12 miles from Upstate, 39.1% of patients resided 12.1–48 miles from Upstate and 17.9% of patients resided greater than 48 miles from Upstate. Only 10.8% of the sample resided in nonmetropolitan areas. The majority of the patients in this study (93.5%) identified as White, with the remainder of the sample identifying as Black or Other. The majority of the sample (98.2%) had health insurance at the time of diagnosis. Most patients (48.9%) were covered under Medicare, followed by patients who were covered under private insurance (25.9%). The remainder of patients were covered under Medicaid (17.7%) or other forms of insurance (5.7%). Roughly, three fourth of the sample identified as male. At the time of diagnosis, many patients were former or current smokers, 45.6% and 34.7%, respectively. Only 19.7% of patients reported no former or current tobacco use. In total, 60.7% of the sample had HPV negative cancer, but 18.5% of patients had no immunohistological evaluation of HPV status. Roughly half the sample (52.5%) initiated treatment within 1 month of presenting to Upstate. 47.2% of patients received a surgical intervention as part of their treatment course and 53.6% of patients had a biopsy proven squamous cell carcinoma of the head and neck prior to presenting to Upstate. The mean index of medical underservice was 55.7. The mean age at diagnosis was 64.0 years. On average, patients had a 43.9-day interval from their initial presentation for HNC to their presentation to Upstate. The average time from first presentation to time of referral was 32.3 days, while the average time from referral to presentation to Upstate was 19.0 days. The duration of time from presentation to Upstate to definitive biopsy or imaging studies was 23.6 and 25.8 days, respectively. The average number of days between presentation to Upstate and initiation of definitive treatment was 45.3 days. The average proportion of the patients' home county with a college degree was 29.8%. The average household income at the level of the zip code was \$59,206.

Chi-square and independent sample T-tests were used to assess for differences in sociodemographic and clinical variables between the two study groups (Tables 2 and 3). A higher proportion of patients in the reference group resided in metropolitan areas when compared to their counterparts in the outlier group, $\chi^2(4) = 9.92, p = .042$. Those from the reference group had a lower mean index of medically

underserved score, $t(467) = -2.44, p = .015$, and had a shorter duration from first presentation for HNC to presentation to Upstate, $t(319.33) = -5.66, p < .001$. Correspondingly, patients in the reference group had a shorter duration from referral to presentation to Upstate, $t(144.01) = -5.23, p < .001$. Despite these differences in rurality and clinical timepoints, there was no significant difference in 2-year DFS between the groups.

Chi-square and one-way ANOVA tests were used to assess for differences in our patient population by distance from Upstate using the categories outlined above (Tables 4 and 5). There was a significant association between distance to Upstate and race, $\chi^2(3) = 45.01, p < .001$. The group that lived ≤ 3 miles from Upstate had the highest proportion (14.1%) of patients who identify as Black. There was a significant association between distance from Upstate and insurance status, $\chi^2(3) = 34.38, p < .001$, with the ≤ 3 miles from Upstate group having the lowest proportion (40.4%) of patients on Medicare insurance. There was a significant association between distance from Upstate and HPV status, $\chi^2(3) = 11.27, p = .08$, with the >48 miles group having the highest proportion (73.0%) of patients with HPV positive HNC. There was a significant association between distance from Upstate and treatment within 1 month of presentation, $\chi^2(3) = 8.14, p = .043$. The group that lived 3.1–12 miles from Upstate had the highest proportion (56.6%) of patients initiating treatment within 1 month of presentation. There was a significant association between distance from Upstate and surgical intervention, $\chi^2(3) = 16.48, p < .001$, with the >48 miles group having the highest proportion (62.6%) of patients receiving a surgical intervention as part of their care. There was a significant association between distance from Upstate and biopsy prior to presentation, $\chi^2(3) = 10.90, p = .012$, with the >48 miles group having the highest proportion (60.7%) of patients completing a biopsy prior to presentation.

There was a significant association between distance from Upstate and index of medial underservice, $F(3) = 11.48, p < .001$. Counties >48 miles from Upstate had the lowest mean index at 54.5. There was a significant association between distance to Upstate and age at diagnosis, $F(3) = 7.15, p < .001$. Those who live 3.1–12 miles from Upstate were on average 6.12 years older than their counterparts who live <3 miles from Upstate, mean difference = -6.12 95% CI ($-10.12, -2.14$), $p < .001$. There was a significant association between distance from Upstate and time of biopsy, $F(3) = 2.78, p = .041$. Those who live >48 miles from Upstate completed a biopsy 15.6 days sooner when compared to their counterparts who live ≤ 3 miles from Upstate, mean

TABLE 2 Chi-square analysis covariates between sample groups.

	Reference group	Outlier group	χ^2	df	p value
Distance					
Less than 3.0 miles	68 (20.2)	31 (18.0)			
3.1–12 miles	82 (24.3)	38 (22.1)			
12.1 to 48 miles	129 (38.3)	70 (40.7)			
Greater than 48.1 miles	58 (17.2)	33 (19.2)	0.933	3	.82
Rural–Urban Continuum Code					
1	3 (0.9)	0 (0)			
2	289 (85.8)	138 (80.2)			
3	16 (4.7)	8 (4.7)			
4	17 (5.0)	21 (12.2)			
6	12 (3.6)	5 (2.9)	9.92	4	.042
2-year disease free survival					
Yes	154 (54.2)	80 (54.1)	0.001	1	0.973
No	130 (45.8)	68 (45.9)			
Race					
White	319 (94.7)	157 (91.3)			
Black	11 (3.3)	7 (4.1)	2.91	2	0.23
Other	7 (2.1)	8 (4.7)			
Insurance					
None	8 (2.4)	1 (0.6)			
Medicaid	58 (17.2)	32 (18.7)			
Medicare	163 (48.4)	86 (50.3)	3.63	4	0.46
Private	91 (27.0)	40 (23.4)			
Other	17 (5.0)	12 (7.0)			
Sex					
Male	248 (73.6)	129 (75.0)	0.118	1	0.731
Female	89 (26.4)	43 (25.0)			
Smoking history					
Never	74 (22.0)	26 (15.1)			
Former	115 (34.2)	61 (35.)			
Current	146 (43.5)	85 (49.4)	4.21	3	0.24
HPV status					
Negative	204 (60.5)	105 (61.4)			
Positive	76 (22.6)	30 (17.5)	2.44	2	0.30
Unknown	57 (16.9)	36 (21.1)			
Stage at diagnosis					
1	68 (20.8)	45 (27.1)			
2	126 (38.5)	54 (32.5)			
3	58 (17.7)	32 (19.3)			
4	75 (22.9)	35 (21.1)	3.31	3	0.35
Surgery					
No	180 (53.4)	89 (51.7)	0.127	1	0.721
Yes	157 (46.6)	83 (48.3)			

Note: Bold values demonstrate clinical significance.

difference = -15.6 , 95% CI (1.59, 29.60), $p = .022$. There was a significant relationship between distance to Upstate and percent of individuals with a college degree at the level of the county, $F(3) = 247.87$,

$p < .001$. The communities that fell within 12.1–48 miles had on average 10.5% less residents with a college degree when compared to communities ≤ 3 miles from Upstate and 10.4% less when compared to

TABLE 3 T-test analysis of covariates between sample groups.

	Reference group	Outlier group	t	df	p value
Index of Medically Underservice Score	55.5 (2.4)	56.1 (2.3)	-2.44	467	.015
Age	63.9 (12.3)	64.3 (10.1)	-0.334	407.43	.739
First seen to Upstate	33.6 (56.2)	64.6 (57.7)	-5.66	319.33	<.001
Referral to Upstate	9.2 (5.0)	36.0 (61.3)	-5.23	144.01	<.001
Percent College Degree ^a	30.1 (6.9)	29.2 (6.8)	1.37	507	.171
Median household income ^b	59,578 (17,643)	58,476 (17,261)	0.671	507	.50

Note: Bold values demonstrate clinical significance.

^aReported at the level of the county.

^bReported at the level of the zip code, unit is dollars.

communities 3.1–12 miles, mean differences = 10.52, 95% CI (9.13, 11.91), $p < .001$ and 10.44, 95% CI (9.14, 11.91), $p < .001$, respectively. Similarly, the communities that fell beyond 48 miles from Upstate had on average 11.2% less residents with a college degree when compared to communities ≤ 3 miles from Upstate and 11.1% less when compared to communities 3.1–12 miles, mean differences = 11.20, 95% CI (9.56, 12.84), $p < .001$ and 11.11, 95% CI (9.54, 12.69), $p < .001$, respectively. There was a significant relationship between distance to Upstate and median household income at the level of the zip code, $F(3) = 139.86$, $p < .001$. On average, zip codes within 3 miles from Upstate reported the lowest median household income at \$39,106. Zip codes >48 miles from Upstate and 12.1–48 miles reported median incomes of \$59,206 and \$62,041, respectively. Zip codes from 3.1 to 12 miles from Upstate had the highest reported median household income at \$74,317.

4 | DISCUSSION

In our study, distance traveled for care was not significantly associated with 2-year DFS among patients newly diagnosed with HNC. Patients in the outlier group were noted to have traveled similar distances when compared to the reference group. However, there was an association between index of medical underservice and rurality with delayed clinical time courses. Further investigation is needed to determine if these delays ultimately influence morbidity and mortality for these patients beyond 2 years. Notably, we did not find an increased prevalence of smoking or advanced stage at presentation in patients traveling farther distances – which has been demonstrated in previous studies.^{8,12–14}

Our findings are similar to a study conducted by an academic institution about 100 miles from ours, where distance was not found to be a significant factor in 5-year overall survival of HNC patients.⁷ This study concluded that rurality played a large role in HNC patient survival outcomes and distance to a cancer center alone could not fully explain disparities in outcomes.⁸ The literature varies on the role of travel distance in HNC survival, with multiple studies demonstrating associations between travel distance and improved outcomes.^{7,14,15} A 2019 study demonstrated that patients traveling less than 5 miles for care had decreased overall survival when compared to their counterparts

traveling longer distances. This difference was suspected to be secondary to travel distance being a potential indicator of socioeconomic status, as distance had a smaller effect size on survival when stratified by income.⁵ However, when investigating overall, disease-specific, and disease-free survival at 2 and 5 years after diagnosis, researchers discovered that increased distance from a cancer center was associated with increased mortality.¹⁶ Other studies have determined that travel time was associated with advanced T stage at diagnosis.¹³

The subset of patients traveling the shortest distance from our institution did not have poorer survival. However, these patients were more likely to have lower income and lower level of education, and were more likely to identify as Black. This group also had a longer DTI when compared to those living farther away. Previous research has demonstrated that prolonged DTI may result in poorer locoregional disease control and overall survival.¹⁷ A systematic review of nearly 150 studies published in 2022 also concluded that socioeconomic resources play a critical role in mortality outcomes in HNC. The authors reported mixed results based on patient location but found that Black, socioeconomically disadvantaged, and male patients have worse outcomes.¹⁴

Practitioners and researchers have expressed a need for additional research to be performed to identify specific disparities in HNC care in an aim to address them.¹⁴ In a similar intention, our study evaluated work up time points to determine if a specific delay was contributing to variable outcomes. Interestingly, although the outlier group had significantly longer time from first seen for symptoms related to HNC and time from referral to presentation at our institution, there was no significant differences in DFS.

Patients in the outlier group were more likely to be from a non-metropolitan county. On average, patients completed a biopsy 7.4 days prior to presentation, suggesting local providers are accurately suspecting and diagnosing HNC and referring patients to our academic center in a timely manner. There were significant differences in index of medical underservice, race, insurance status, and HPV status between the distance groups. Taken together, our findings suggest that although rurality appears to play a role in the clinical course of HNC, there are additional factors that affect patients traveling farther distances, which may impact their survivability. In particular, the higher rate of HPV positive disease found in patients traveling

TABLE 4 Chi-Square analysis of covariates by distance to Upstate.

	≤3 miles	3.1–12 miles	12.1–48 miles	> 48 miles	χ^2	df	p value
Race							
White	80 (80.8)	114 (95.0)	193 (97.0)	89 (97.8)	45.01	3	<.001
Black	14 (14.1)	1 (0.8)	2 (1.0)	1 (1.1)			
Other	5 (5.1)	5 (4.2)	4 (2.0)	1 (1.1)			
2-year disease free survival							
Yes	44 (53.0)	62 (58.5)	88 (51.8)	40 (54.8)	1.25	3	.74
No	39 (47.0)	44 (41.5)	82 (45.2)	33 (45.2)			
Insurance status							
None	4 (4.0)	0 (0.0)	2 (1.0)	3 (3.3)	34.38	3	<.001
Medicaid	31 (31.3)	13 (10.8)	36 (18.1)	10 (11.0)			
Medicare	40 (40.4)	72 (60.0)	86 (43.2)	51 (56.0)			
Private	21 (21.2)	28 (23.3)	61 (30.7)	22 (24.2)			
Other	3 (3.0)	7 (5.8)	14 (7.0)	5 (5.5)			
Sex							
Male	67 (67.7)	87 (72.5)	155 (77.9)	68 (74.7)	3.79	3	.29
Female	32 (32.3)	33 (27.5)	44 (22.1)	23 (25.3)			
Smoking status							
Never	18 (18.2)	25 (21.2)	38 (19.1)	19 (20.9)	7.87	3	.25
Former	39 (39.4)	62 (52.5)	86 (43.2)	44 (48.4)			
Current	42 (42.4)	31 (26.3)	75 (37.7)	28 (30.8)			
HPV status							
HPV positive	62 (65.3)	69 (58.0)	113 (57.7)	65 (73.0)	11.27	3	.08
HPV negative	18 (18.9)	32 (26.9)	47 (24.0)	9 (10.1)			
HPV unknown	15 (15.8)	18 (15.1)	36 (18.4)	15 (16.9)			
Clinical stage							
Stage 1	19 (19.8)	30 (25.9)	40 (20.6)	24 (27.6)	12.34	3	.20
Stage 2	41 (42.7)	46 (39.7)	64 (33.0)	29 (33.3)			
Stage 3	12 (12.5)	24 (20.7)	39 (20.1)	15 (17.2)			
Stage 4	24 (25.0)	16 (13.8)	51 (26.3)	19 (21.8)			
Upstate to treatment within 1 month							
Yes	35 (36.8)	64 (56.6)	89 (47.1)	41 (48.2)	8.14	3	.043
No	60 (63.2)	49 (43.4)	100 (52.9)	44 (58.1)			
Surgical intervention							
Yes	33 (33.3)	58 (48.3)	92 (46.2)	57 (62.6)	16.48	3	<.001
No	66 (66.7)	62 (51.7)	107 (53.8)	34 (37.4)			
Biopsy prior to presentation to Upstate							
Yes	39 (39.4)	70 (58.3)	107 (54.0)	54 (60.7)	10.90	3	.012
No	60 (60.6)	50 (41.7)	91 (46.0)	35 (39.3)			

Note: Bold values demonstrate clinical significance.

farther distances is a potential confounding variable with regards to our study population's disease-free survival and treatment modality decision. It has been well established that HPV positive oropharyngeal SCC is associated with improved survival and less chance of recurrence when compared to HPV negative disease.¹⁸ Additionally, studies have demonstrated that people residing in regions located farther from hospital systems have increased rates of medical

comorbidities.^{12,19} We did not include comorbidities in the present study, but suspect that this component, in conjunction with the barriers to follow-up and surveillance associated with increased remoteness, were responsible for the differences in clinical timepoints. We intend to investigate this association in future studies.

There are several limitations to our study. The retrospective nature of the study limits the data collection to information present in

TABLE 5 One-way ANOVA analysis of covariates by distance to Upstate.

	≤3 miles	3.1–12 miles	12.1–48 miles	>48 miles	F	df	p value
Index of Medically Underservice Score	55.7	55.8	56.3	54.5	11.48	3	<.001
Age	61.8 (10.7)	68 (12.7)	62.6 (11.9)	64.5 (9.0)	7.15	3	<.001
First seen to Upstate	43.9 (63.4)	37.3 (37.0)	46.6 (67.5)	46.8 (55.8)	0.69	3	0.56
Referral to Upstate	31.8 (81.2)	14.4 (17.8)	16.7 (20.5)	17.8 (23.8)	2.60	3	.052
Upstate to Biopsy	−0.63 (27.4)	−6.8 (41.6)	−7.2 (41.0)	−16.2 (1.0)	2.78	3	.041
Upstate to imaging	11.2 (59.3)	6.1 (36.8)	10.4 (35.8)	18.3 (36.1)	1.41	3	.24
Upstate to treatment	48.5 (39.6)	39.2 (37.0)	46.3 (54.2)	47.8 (82.4)	0.662	3	.58
Percent College Degree	35.9 (0.00)	35.8 (0.93)	25.4 (6.6)	24.7 (3.5)	247.87	3	<.001
Household income	39,106 (9738)	74,317 (15,829)	2041 (12,554)	59,206 (17,506)	139.86	3	<.001

Note: Bold values demonstrate clinical significance.

the patient charts. In our study, DFS was limited to retrospective assessment at 2 years post diagnosis. A longer follow up time period could better assess the sustained effect of distance on patient outcomes. We also could not account for patients lost to follow-up. Future studies would be beneficial to discern if this loss to follow-up is associated with travel distance.

5 | CONCLUSION

Our study demonstrates an association between rurality and delay in HNC workup but was not found to lead to worsened 2-year DFS. Additionally, although distance traveled to our academic center for HNC was associated with some clinical timepoints, this had no impact on DFS. Together, we suggest these findings support that socioeconomic and patient factors, instead of travel distance alone, influence HNC work up patterns.

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