AMERICAN ACADEMY OF OTOLARYNGOLOGY–HEAD AND NECK SURGERY FOUNDATION

OTO Open
2024, Vol. 8(4):e70057

DOI: 10.1002/oto2.70057
http://oto-open.org
WILEY

Association of Neighborhood-Level Area Deprivation with Demographics and Outcomes in Oropharyngeal Squamous Cell Carcinoma

Shravan Asthana, BS[1]*, Asher C. Park, BS[1]*, Abhinav Talwar, MD, MBA[1], Kirsten B. Burdett, MS[2], Christopher Puchi, MD[1], Ahmed Ibrahim, MD[1], Olivia Dunne, BS[1], Urjeet Patel, MD[1], Sandeep Samant, MD[1], and Katelyn O. Stepan, MD[1]

Abstract

Objective. To characterize neighborhood-level area deprivation's association with oropharyngeal carcinoma clinicodemographics, tumor staging, recurrence, and overall survival.

Study Design. Retrospective study.

Setting. Single institution academic medical center.

Methods. Patients diagnosed with oropharyngeal squamous cell carcinoma (OPSCC) between 2007 and 2022 at our institution were included in this study. The Area Deprivation Index (ADI) was used to quantify neighborhood-level disadvantage based on patients' primary residence at the time of their diagnosis. Continuous variables were compared between groups using the Wilcoxon rank sum test. For categorical variables, proportions were compared using Fisher's exact test. Overall survival (OS) and recurrence-free survival (RFS) distributions were estimated using the Kaplan-Meier method and log-rank test. OS and RFS were further assessed by univariable and multivariable analyses performed using the Cox proportional hazards model.

Results. The higher ADI (more disadvantaged) group consisted of a significantly greater proportion of Black race ($P < .001$), 10+ pack-year smoking history ($P = .003$), and Medicare patients ($P = .018$). On logistic regression analysis, neither ADI nor other social factors were significantly associated with increased likelihood of advanced clinical staging in the p16 positive OPSCC population. Furthermore, while ADI did not correspond with significant differences in survival, multivariate cox regression model demonstrated that "Other" insurance type (Medicaid and uninsured) (hazard ratio [HR] = 10.1, $P = .008$), age at diagnosis (1.10, $P < .001$), and advanced clinical staging (HR = 3.25, $P = .004$) were all significantly associated with increased HR of death.

Conclusion. While ADI may not be significantly associated with outcomes in HPV-related OPSCC patients, this study revealed significant sociodemographic and risk factor differences across ADIs, as well as individual factors influencing prognosis. These findings emphasize the need for a comprehensive approach to understanding factors influencing HPV-related OPSCC incidence and prognosis.

Keywords

area deprivation index, oropharyngeal carcinoma, p16, smoking, Social vulnerability index, tumor staging

Received September 5, 2024; accepted November 8, 2024.

Oropharyngeal squamous cell carcinoma (OPSCC) is an increasingly common and significantly burdensome malignant neoplasm of the oropharyngeal epithelial lining.[1] In the United States, human papilloma virus (HPV) accounts for approximately 70% of all OPSCC. This has impacted the clinical paradigm where the 8th edition American Joint Committee on Cancer (AJCC) stratifies HPV-positive and HPV-negative OPSCC as distinct cancers with unique etiologies, prognoses, and management.[2,3] Relative to HPV-negative cancers, HPV-positive OPSCC is more common in younger patients and is more

[1]Department of Otolaryngology–Head and Neck Surgery, Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA
[2]Department of Preventive Medicine, Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA
*These authors contributed equally to this article.

This article was presented at the AAO-HNSF 2023 Annual Meeting & OTO Experience; September 30-October 4, 2023; Nashville, Tennessee

Corresponding Author:
Katelyn O. Stepan, MD, Department of Otolaryngology–Head and Neck, Northwestern University Feinberg School of Medicine, 420 E Superior St, Chicago, IL 60611, USA.
Email: katelyn.stepan@nm.org

associated with sexual behaviors rather than tobacco and alcohol use.[4,5] Furthermore, HPV-positive OPSCC tends to present with less advanced tumor staging and has improved survival.[2,6,7] Recent research has shifted towards evaluating prevention and early detection of the disease, with HPV vaccination and screening emerging as a crucial public health measure to limit HPV-positive OPSCC.[5,8,9]

Furthermore, increasing focus has been placed on the social determinants of health (SDOH) in OPSCC patients. In an analysis of the national Surveillance, Epidemiology, and End Results (SEER) database from 1973 to 2004, Chaturvedi et al demonstrated that increased incidence of HPV-related OPSCC is seen among White men and younger individuals.[4] Settle et al expand on this association, demonstrating that White OPSCC patients are significantly more likely to be HPV-positive than Black patients.[10] These racial disparities in HPV status suggest an unequal OPSCC burden, and this has emerged in investigations of both clinical presentation and survival.[11] African American race has been shown to be associated with increased odds of advanced AJCC stage upon presentation.[12] Pike et al demonstrated that in primary nonmetastatic head and neck SCCs, HPV-positivity was associated with higher education, insurance status, and White race; amongst HPV-positive cancers, lower cancer-specific mortality was associated with White race.[13]

While individual factors such as race, ethnicity, socioeconomic status, and age have been previously explored in the context of HPV status and OPSCC prognosis, less is known about how neighborhood-level disadvantage influences these disparities. The Area Deprivation Index (ADI) is a validated instrument that has been studied among a number of disorders and malignancies.[14] ADI provides a numeric score based on social and economic factors associated with a neighborhood of residence. Cheng et al recently published a study showing that higher area deprivation is associated with decreased survival in breast, prostate, lung, and colorectal cancers.[15] Although geographically based indices of SDOH are receiving more attention as of late, ADI is relatively understudied in head and neck cancers.

This study aims to investigate the relationship between geographic level social determinants of health, as measured by the ADI, and patient/tumor characteristics as well as outcomes in HPV-related oropharyngeal squamous cell carcinoma.

Methods

This study received IRB approval from Northwestern University.

Study Population, Exposures, and Outcomes

This retrospective study includes patients diagnosed with p16-positive OPSCC between 2007 and 2022 at our institution. To be included in the analysis, patients needed complete tumor staging, vital status and follow-up, and residential address information available. A comprehensive set of demographic and clinical variables were collected for each patient, including race, sex, ethnicity, age at diagnosis, smoking status (pack-years), tumor subsite, AJCC 8th Edition tumor staging, p16 marker status, treatment modalities, recurrence status, recurrence type, and vital status. HPV-related disease was determined by positive p16 marker status.

Outcomes evaluated included advanced clinical tumor staging, overall survival, and recurrence-free survival. Advanced clinical staging is defined as AJCC 8th edition level III or above.

ADI

The ADI from the University of Wisconsin Neighborhood Atlas was used to quantify neighborhood-level disadvantage to patients based on their primary residence at the time of their diagnosis.[14] The Neighborhood Atlas provides ADI scores for neighborhoods defined by census block groups, the smallest geographic unit provided by the US Census. ADI scores are constructed based on a 17-component index comprising domains of income, education, employment, and housing quality originally conceived by Gopal et al.[16]

In this investigation, patient addresses were abstracted from the electronic medical record and converted into census block groups corresponding to the US Census Bureau American Community Survey Federal Information Processing Standards (FIPS) codes. The open-source neighborhood atlas data was then indexed across their repository of FIPS codes to collate corresponding ADI scores to our patients. Therefore, patients with higher ADI scores reside in neighborhoods with correspondingly higher deprivation relative to other scores in the Atlas. In the study population, high ADI was subsequently defined as a national rank score at or above 51 in concordance with previously reported studies utilizing ADI.[17,18]

Statistical Analysis

The primary objective was to investigate the association between ADI and advanced staging. Advanced staging was defined as overall clinical stage III to IV. The association between ADI and advanced staging was assessed using univariable and multivariable logistic regression models with outcome being advanced staging. The multivariable model included baseline clinical potential confounders as additive effects. Results presented included odds ratios (OR), confidence intervals (CI), and corresponding *P*-values. Secondary objectives included investigating the association between ADI and overall survival (OS) as well as recurrence free survival (RFS). OS is defined as time from diagnosis to death (any cause) with censoring at 5 years. RFS is defined as time from diagnosis to recurrence or death (any cause), with censoring at last available follow-up. OS and RFS

distributions were estimated using the Kaplan-Meier method and log-rank test, and survival estimates were reported with the corresponding 95% CI along with OS and RFS. OS and RFS were further assessed by univariable and multivariable Cox proportional hazards models adjusting for baseline clinical potential confounders as additive effects. Results presented included hazard ratios (HR) and associated CI, along with Wald *P*-values. Proportional hazards assumptions were assessed prior to fitting the Cox models and satisfied.

Descriptive statistics were used to summarize baseline characteristics. Continuous variables were summarized using median and interquartile range (IQR) and compared between groups using the Wilcoxon rank sum test. For categorical variables, frequencies and percentages were reported, and proportions were compared using Fisher's exact test. Frequencies of missing observations were tabulated, and missing observations were not included in these descriptive analyses. Analyses were conducted at the 0.05 significance level reporting 2-sided unadjusted *P*-values and 2-sided 95% CI. All statistical analyses were performed using R version 4.2.2.

Results

Study Population

Initial data collected included 408 patients with p16-positive OPSCC. The median age was 60.0 (interquartile range [IQR] 53.8-67.0), and patients were primarily male (365, 89.5%) and White (362, 88.7%). There were 324 patients in the low ADI category and 84 in the high ADI category. Additional clinicodemographic factors of patients with p16-positive OPSCC are reported in **Table 1**.

Table 1. p16-Positive Oropharynx Cancer Population Clinicodemographics

Characteristic	Overall, N = 408
Age at diagnosis	
Median (IQR)	60.0 (53.8, 67.0)
Range	29.0, 88.0
Sex	
Female	43 (10.5%)
Male	365 (89.5%)
Race	
White	362 (88.7%)
Black or African American	28 (6.9%)
Other	18 (4.4%)
Ethnicity	
Not Hispanic/Latino	391 (95.8%)
Hispanic/Latino	17 (4.2%)
Smoking status	
Never Smoker	221 (54.2%)
0-10 Pack Years	47 (11.5%)
10+ Pack Years	140 (34.3%)
Payer type	
Medicare	187 (45.8%)
Private/commercial	213 (52.2%)
Other	8 (2.0%)
Tumor subsite	
Neck-unknown	11 (2.7%)
Posterior pharyngeal wall	2 (0.5%)
Soft palate	2 (0.5%)
Tongue Base	140 (34.3%)
Tonsil	253 (62.0%)
Clinical stage	
Stage I	260 (63.7%)
Stage II	110 (27.0%)
Stage III	22 (5.4%)
Stage IV-IVc	16 (3.9%)
T-Stage	
Tx	5 (1.2%)
T0	41 (10.0%)
T1	125 (30.6%)
T2	165 (40.4%)
T3	41 (10.0%)
T4-4b	31 (7.6%)
Treatment	
Surgery only	38 (9.3%)
Surgery with adjuvant therapy	195 (47.8%)
Other	175 (42.9%)
ADI raw scores	
Median (IQR)	30.0 (15.0, 47.0)
Range	1.0, 94.0
Continuous 10 Scaled ADI	
Median (IQR)	3.0 (1.5, 4.7)
Range	0.1, 9.4
Low/high ADI	
0-50 ADI	324 (79.4%)
51-100 ADI	84 (20.6%)

ADI and Clinicodemographic Factors

When stratifying by ADI low (0-50 ADI, n = 84) and high (51-100 ADI, n = 324) groups, there were significant differences in race, smoking factors, and payer type between groups. The higher ADI group consisted of a significantly greater proportion of Black race (16.7% vs 4.3%, $P < .001$) and patients with a 10+ pack-year smoking history (47.6% vs 30.9%, $P = .003$), as highlighted in **Table 2**. Furthermore, a significantly higher proportion of patients had Medicare within the high ADI group compared to low ADI (53.6% vs 43.8%, $P = .018$). Meanwhile, no significant differences were found in age, gender, treatment type, tumor subsite, or clinical stage when stratified by ADI group. These findings were similar when looking at the entire (p16-positive and -negative) population.

Advanced Clinical Tumor (T) Staging

Seventy-two patients presented with advanced clinically staged disease (stage III-IV). On neither univariable nor multivariable analysis was ADI or other factors

Table 2. Clinicodemographic Factors Stratified by ADI Group for the p16-Positive Only Oropharynx Cancer Population

Characteristic	Low ADI, N = 324	High ADI, N = 84	*P* value
Age at diagnosis			.96
Median (IQR)	60.0 (54.0, 67.0)	59.5 (53.0, 67.0)	
Sex			.55
Female	36 (11.1%)	7 (8.3%)	
Male	288 (88.9%)	77 (91.7%)	
Race			<.001
White	296 (91.4%)	66 (78.6%)	
Black	14 (4.3%)	14 (16.7%)	
Other	14 (4.3%)	4 (4.8%)	
Ethnicity			.76
Not Hispanic/Latino	311 (96.0%)	80 (95.2%)	
Hispanic/Latino	13 (4.0%)	4 (4.8%)	
Smoking status			.003
Never Smoker	189 (58.3%)	32 (38.1%)	
0-10 Pack Years	35 (10.8%)	12 (14.3%)	
10+ Pack Years	100 (30.9%)	40 (47.6%)	
Payer type			.018
Medicare	142 (43.8%)	45 (53.6%)	
Private/commercial	178 (54.9%)	35 (41.7%)	
Other	4 (1.2%)	4 (4.8%)	
Tumor subsite			.85
Neck-unknown	8 (2.5%)	3 (3.6%)	
Pharyngeal wall	2 (0.6%)	0 (0.0%)	
Soft palate	2 (0.6%)	0 (0.0%)	
Tongue base	109 (33.6%)	31 (36.9%)	
Tonsil	203 (62.7%)	50 (59.5%)	
Clinical stage			.48
Stage I	210 (64.8%)	50 (59.5%)	
Stage II	87 (26.9%)	23 (27.4%)	
Stage III	15 (4.6%)	7 (8.3%)	
Stage IVa-c	12 (3.7%)	4 (4.8%)	
T-Stage			.36
Tx	4 (1.2%)	1 (1.2%)	
T0	34 (10.5%)	7 (8.3%)	
T1	102 (31.5%)	23 (27.4%)	
T2	133 (41.0%)	32 (38.1%)	
T3	31 (9.6%)	10 (11.9%)	
T4-4b	20 (6.2%)	11 (13.1%)	
Treatment			.76
Surgery only	32 (9.9%)	6 (7.1%)	
Surgery with adjuvant therapy	153 (47.2%)	42 (50.0%)	
Other	139 (42.9%)	36 (42.9%)	

associated with increased odds of advanced staging. However, patients with high ADI (OR = 1.66, $P = .198$), of Black or African American race (OR = 2.24, $P = .301$), and Hispanic/Latino ethnicity (OR = 2.18, $P = .274$) insignificantly trended toward higher likelihood of advanced tumor staging (**Table 3**).

Overall and Recurrence-Free Survival

There were 38 deaths in the p16-positive patient population with a median follow-up time of 3.1 years among patients alive at the end of the study. Among p16-positive patients OS was 92% (95% CI: 88.3, 94.6) at 3 years and 84.7% (95% CI: 79.3, 88.8) at 5 years, while median OS was not reached. After stratifying by ADI group, analysis failed to reveal a significant decrease in OS on unadjusted log-rank testing with 5-year OS probabilities of 86.8% and 77.0%, respectively (**Figure 1**).

On univariable Cox proportional hazard models, high ADI was insignificantly associated with an increased hazard of death in the p16-positive population compared to low ADI (HR = 1.80, $P = .093$) (**Table 4**). Meanwhile, on univariable analysis Black or African American race (HR = 3.39, $P = .009$) was associated with an increased hazard of death relative to patients of White race, although this did not reach significance on multivariate analysis. Similarly, patients who received a treatment regimen other than surgery alone or surgery with adjuvant treatment exhibited an increased HR = 3.98 of death ($P = .041$), although this did not persist in the multivariable model. On multivariable analysis, "Other" insurance type, consisting of Medicaid and uninsured patients (HR = 10.1, $P = .008$), age at diagnosis (1.10, $P < .001$), and advanced clinical staging (HR = 3.25, $P = .004$) were all significantly associated with increased HR of death. Furthermore, Kaplan-Meier curves for OS stratified by insurance coverage type displayed a significantly decreased survival probability in the insurance payer type ($P < .001$) in the p16-positive population (Supplemental Figure S1, available online).

RFS Kaplan-Meier curves and log-rank testing showed a trend towards decreased ($P = .120$) survival probability in high ADI in the p16-positive population with a 5-year RFS of 64.5% relative to 76.8% in the low ADI group, though this difference was not significant (**Figure 2**). Stratification by payer type similarly revealed a significant difference in RFS ($P = .009$) (Supplemental Figure S2, available online).

Discussion

This study examines the interplay between SDOH, neighborhood-level disparities, and clinical outcomes in OPSCC using the validated ADI. Amid the increasing incidence of OPSCC linked to HPV infection and changing risk factors, this research adds valuable insights to current understanding of the disease. While prior studies have delved into socioeconomic and racial disparities, there is a scarcity of literature on geographic-level SDOH in OPSCC outcomes.

A higher proportion of p16-negative patients was found in the high area deprivation group, aligning with existing literature associating HPV-negative disease with lower socioeconomic status.[19] Given the differences in staging and prognosis associated with p16 status, a separate analysis was conducted looking only at the

Table 3. Univariable and Multivariable Logistic Regression in Advanced Clinical Staging for the P16-Positive Only Oropharynx Cancer Population

	Univariable				Multivariable			
Characteristic	N	OR	95% CI	*P* value	Event N	OR	95% CI	*P* value
ADI				.198	38			.243
Low ADI	324	—	—			—	—	
High ADI	84	1.66	0.76, 3.42			1.64	0.71, 3.58	
Age at diagnosis	408	1.02	0.98, 1.05	.400	38	1.00	0.96, 1.05	.879
Sex				.295	38			.311
Female	43	—	—			—	—	
Male	365	0.59	0.25, 1.65			0.59	0.24, 1.71	
Race				.301	38			.260
White	362	—	—			—	—	
Black or African American	28	2.24	0.72, 5.89			2.27	0.68, 6.48	
Other	18	0.61	0.03, 3.11			0.46	0.02, 2.46	
Ethnicity				.274	38			.233
Not Hispanic/Latino	391	—	—			—	—	
Hispanic/Latino	17	2.18	0.49, 7.08			2.41	0.52, 8.34	
Smoking status				.380	38			.171
Never smoker	221	—	—			—	—	
0-10 pack years	47	0.40	0.06, 1.43			0.28	0.04, 1.05	
10+ pack years	140	1.01	0.49, 2.02			0.79	0.37, 1.65	
Payer type				.159	38			.206
Medicare	187	—	—			—	—	
Private/commercial	213	0.61	0.31, 1.19			0.63	0.25, 1.54	
Other	8	0.00				0.00		
No. Obs.						408		
AIC						262		

Abbreviations: CI, confidence interval; OR, odds ratio.

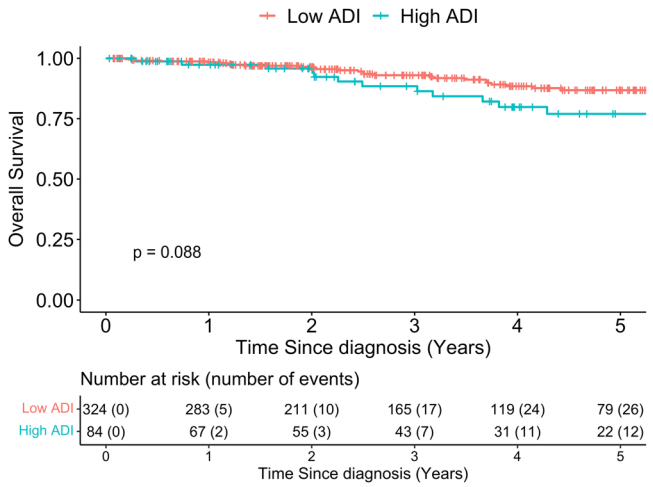

Figure 1. Kaplan-Meier overall survival curves stratified by ADI group in the p16-positive only cancer population.

p16-positive population. Among p16-positive patients there was a significantly higher proportion of Black or African American race, and 10+ pack year smoking history among patients in the high ADI group. However, ADI was not found to be significantly correlated with advanced clinical staging presentation. Similarly, there was no significant decrease in survival probability on unadjusted log-rank testing when stratifying by ADI when censoring at 5 years. Also, there was no significant difference in RFS between the high and low ADI groups. Furthermore, on multivariable analysis there was no significant difference in OS or RFS between high and low ADI groups. In concert, these findings suggest that ADI may be more predictive of HPV status, race, smoking history, and other social factors across the oropharyngeal cancer population. When isolated to p16-positive cancers, ADI alone did not correspond with important clinical outcomes such as advanced staging at presentation or survival.

Nevertheless, race, insurance payer, smoking status, and socioeconomic factors have previously been linked to advanced tumor staging, recurrence, and survival prognosis across HPV status in head and neck cancer.[11,19–24] A study by Pike et al showed that HPV-positivity was associated with higher education and insurance status, both of which correspond to factors that are more represented by lower ADI scores.[13] Smith et al showed that compared to Medicaid or uninsured patients, patients with Medicare had decreased incidence of head

Table 4. Cox Proportional Hazards Model for Overall Survival in the p16-Positive Only Population

		Univariable			Multivariable		
Characteristic	N	HR	95% CI	*P* value	HR	95% CI	*P* value
ADI				.093			.544
Low ADI	324	—	—		—	—	
High ADI	84	1.80	0.91, 3.57		1.28	0.58, 2.85	
Age at diagnosis	408	1.06	1.03, 1.10	<.001	1.10	1.05, 1.16	<.001
Race				.009			.107
White	362	—	—		—	—	
Black or African American	28	3.39	1.54, 7.44		2.54	1.00, 6.46	
Other	18	1.78	0.42, 7.47		2.18	0.49, 9.65	
Ethnicity				.953			.517
Not Hispanic/Latino	391	—	—		—	—	
Hispanic/Latino	17	1.04	0.25, 4.33		0.58	0.11, 2.97	
Sex				.522			.518
Female	43	—	—		—	—	
Male	365	1.47	0.45, 4.78		1.55	0.41, 5.82	
Smoking status				.344			.125
Never smoker	221	—	—		—	—	
0-10 Pack Years	47	0.41	0.10, 1.76		0.40	0.08, 1.86	
10+ Pack Years	140	1.22	0.63, 2.37		1.71	0.82, 3.56	
Payer Type				.002			.008
Medicare	187	—	—		—	—	
Private/commercial	213	0.57	0.29, 1.13		2.19	0.84, 5.72	
Other	8	5.25	1.56, 17.6		10.1	2.32, 43.7	
Treatment				.041			.355
Surgery only	38	—	—		—	—	
Surgery with adjuvant therapy	195	1.73	0.22, 13.5		1.91	0.24, 15.1	
Other	175	3.98	0.54, 29.4		3.03	0.40, 23.2	
Advanced clinical staging				<.001			.004
Non-advanced	370	—	—		—	—	
Advanced	38	3.75	1.82, 7.73		3.24	1.46, 7.17	

Abbreviations: CI, confidence interval; HR, hazard ratio.

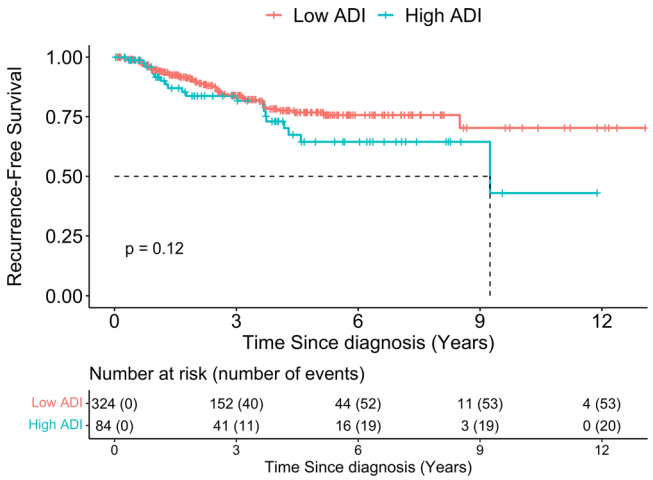

Figure 2. Kaplan-Meier recurrence-free survival curves stratified by ADI group in the p16-positive only cancer population.

and neck squamous cell carcinoma, less advanced staging upon presentation, and lower disease-specific mortality.[24] In line with these results, we found patients with Other insurance type, consisting of Medicaid and uninsured patients, had significantly decreased OS, further emphasizing the role of insurance coverage type in outcome disparities.

Previous studies examining the relationship between race as a SDOH and survival outcomes in OPSCC have shown mixed results. One study by Rotsides et al, reported a significant decrease in OPSCC overall survival among Black patients after adjusting for HPV status, SES, and other variables. In contrast, others, including a study by Lenke et al, have found this survival disadvantage resolves after adjusting for factors including SES.[19,25] The discrepancies in these findings may be attributed to several factors, including differences in study populations, data sources, methods by which SES is measured and adjusted for, and healthcare settings. Rotsides et al

utilized data from the National Cancer Database (NCDB), which encompasses a diverse and broad patient population from various healthcare institutions across the United States. Whereas Lenke et al incorporated 5 studies that looked at populations from smaller databases or single institutions, which may have implications regarding the consistency of care and treatment received by patients. It is possible that receiving multidisciplinary care at a single institution could alleviate some of the disparities associated with SDOH, ultimately leading to the lack of detectable disparity in overall survival related to race or ADI on multivariable analysis as seen in our study. Furthermore, the sample size of our study and the generally high survival rates in OPSCC may have limited our ability to detect differences in survival related to race or area deprivation.

Another potential contributor to the lack of consensus across previous studies may be the measurement of SES or SDOH in these studies. While some studies like Rotsides et al's, used income as a measurement of SES, our study used ADI to capture a wider range of socioeconomic and demographic factors associated with neighborhood-level disadvantage. This highlights that the evaluation of SES and SDOH in the context of OPSCC is an evolving field that requires the further exploration of various methods and indices used to assess SDOH.

The strength of this study includes its use of a validated index to capture social area deprivation, providing a comprehensive view of the socioeconomic landscape of OPSCC which has not previously been published. Existing literature looking at specific SDOH components are consistent with themes highlighted by our results, re-emphasizing the significance of these factors and their contribution to OPSCC outcomes while suggesting that ADI may serve as a valuable tool for identifying patient subgroups that are at a higher risk of presenting with advanced disease or other specific risk factors. ADI provides a feasible opportunity to appreciate where a patient is coming from in more ways than one. Because patient addresses are embedded in modern electronic medical records, composite indices like ADI are readily applicable complements to traditional and potentially lengthy and intrusive SDOH screening. Furthermore, ADI continues to be validated as a tool for geographic socioeconomic risk stratification and presents an exciting opportunity to care for a patient holistically by appreciating the nonmedical circumstances impacting their health and quality of life.

However, this study is not without its limitations. While ADI captures a range of socioeconomic and demographic factors, it does not encompass all possible determinants of health disparities that contribute to the complex interactions between SDOH and patient outcomes. Furthermore, this retrospective study focuses on a specific patient population diagnosed with p16-positive OPSCC at a single institution which may not be representative of the broader population. The patient population at the study institution predominantly had private insurance or Medicare, which likely does not reflect the socioeconomic and demographic diversity found in other regions or healthcare settings. This limits the generalizability of the findings to a more diverse or socioeconomically disadvantaged patient population. Additionally, this study focused on p16-positive OPSCC, which is known to have a relatively favorable prognosis compared to other head and neck cancer subtypes; future studies should be conducted to look at the association between ADI and outcomes in the setting of other head and neck malignancies among a broader patient population.

This study provides a novel investigation on the associations between area deprivation and OPSCC outcomes, emphasizing the need for comprehensive, patient-centered care that accounts for not only medical factors, but SDOH. Future research in this area should aim to explore specific mechanisms through which SDOH interact to influence outcomes in OPSCC. Because index tools such as ADI are limited to preselected SDOH, other SDOH not included in ADI should be further evaluated. For example, previous studies have demonstrated that single-partner marital status is associated with improved survival in OPSCC[26,27]; additional factors such as the role of sexual behaviors and marital status across area deprivation classes in OPSCC should be investigated. Additionally, examination of patient-reported quality of life outcomes as they related to different SDOH is needed, where despite numerous validated instruments, few studies have investigated these disparities.[1,28] The disease burden and psychosocial factors that exist in HPV and non-HPV-related head and neck cancers have been studied but not looked at across different SDOH in the context of OPSCC.[29]

Conclusion

This study underscores the importance of considering social determinants, as measured by the ADI, in the context of HPV-related OPSCC. While ADI was not significantly associated with advanced clinical staging or survival outcomes within this population, ADI was correlated with significant sociodemographic disparities, such as race and smoking history. This emphasizes the importance of a holistic approach to understanding the multifaceted factors influencing cancer prognosis. Future research endeavors should delve deeper into the interplay of these determinants and consider additional variables, such as access to care and treatment efficacy, to provide a more comprehensive understanding of OPSCC outcomes. Such insight can ultimately inform the development of tailored interventions to improve the care and outcomes of at-risk populations within this patient group.

Author Contributions

Shravan Asthana, design, data acquisition, statistical analysis, data interpretation, drafting, and revision; **Asher C. Park**, design, data acquisition, statistical analysis, data interpretation, drafting, and revision; **Abhinav Talwar**, design, data acquisition, statistical analysis, data interpretation, drafting, and revision; **Kirsten B. Burdett**, design, statistical analysis, data interpretation, drafting, and revision; **Christopher Puchi**, data interpretation, drafting, and revision; **Ahmed Ibrahim**, data interpretation, drafting, and revision; **Olivia Dunne**, data acquisition and data interpretation; **Urjeet Patel**, design, data acquisition, and data interpretation; **Sandeep Samant**, design, data acquisition, and data interpretation; **Katelyn O. Stepan**, design, data acquisition, statistical analysis, data interpretation, drafting, revision, and supervision.

Disclosures

Competing interests: None.

Funding source: None.

Supplemental Material

Additional supporting information is available in the online version of the article.

ORCID iD

Shravan Asthana https://orcid.org/0000-0002-1356-3764
Asher C. Park https://orcid.org/0000-0002-3631-463X
Abhinav Talwar http://orcid.org/0000-0001-8385-6119
Kirsten B. Burdett http://orcid.org/0000-0002-3720-2795
Christopher Puchi http://orcid.org/0009-0004-5898-4003
Olivia Dunne http://orcid.org/0000-0002-8757-3543
Urjeet Patel http://orcid.org/0000-0003-3024-0454
Sandeep Samant http://orcid.org/0000-0002-4755-8082
Katelyn O. Stepan http://orcid.org/0000-0002-9193-2561

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