Racial and Ethnic Disparities in Salivary Gland Cancer Survival

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IMPORTANCE Several recent US studies have documented racial disparities in head and neck cancer outcomes, but few have investigated racial and ethnic differences in salivary gland cancer (SGCA) survival.

OBJECTIVE To determine whether patient race or ethnicity affects SGCA survival.

DESIGN, SETTING, AND PARTICIPANTS Retrospective survival analysis of all patients with SGCA from 1988 through 2010 in the Surveillance, Epidemiology, and End Results database.

MAIN OUTCOMES AND MEASURES Disease-specific survival according to race and ethnicity. End points assessed included age at diagnosis, sex, tumor grade, tumor size at diagnosis, extension at diagnosis, lymph node involvement at diagnosis, and treatment. Results were further analyzed by histologic subtype of SGCA.

RESULTS Of 11,007 patients with SGCA, 1,073 (9.7%) were black, and 1,068 (9.7%), Hispanic. Whites’ mean age at diagnosis was 63 years vs 53 and 52 years for blacks and Hispanics, respectively ($P < .001$). Twenty-year disease-specific survival rates for all SGCA histologic subtypes combined for whites, blacks, and Hispanics were 78%, 79%, and 81%, respectively. Unadjusted survival curves showed no significant difference between blacks and whites and an apparent advantage for Hispanics. However, multivariable Cox regression models controlling for patient, tumor, and treatment characteristics showed poorer disease-specific survival vs whites for blacks (hazard ratio [HR], 1.22 [95% CI, 1.03-1.46]; $P = .03$) but not for Hispanics (HR, 0.97 [0.79-1.19]; $P = .77$). The overall disease-specific survival disparity was due to poorer disease-specific survival for blacks vs whites with mucoepidermoid ($P = .03$) and squamous cell carcinomas ($P = .05$). Less surgical treatment for blacks than whites (57.26% vs 76.94%; $P < .001$) was a source of the survival disparity for squamous cell but not mucoepidermoid SGCA.

CONCLUSIONS AND RELEVANCE Black race is a risk factor for poorer disease-specific survival for patients with mucoepidermoid or squamous cell carcinoma, whereas Hispanic ethnicity has no effect. Differing treatment between black and white patients affects survival in squamous cell but not mucoepidermoid SGCA. Differences in chemotherapy treatment, comorbidities, socioeconomic status, tumor genetic factors, and environmental exposures are potential but unproven additional sources of the racial survival disparities for mucoepidermoid and squamous cell SGCA.
Salivary gland cancers (SGCAs) comprise a large variety of histopathologic subtypes, many of uncertain etiology, and as a whole are relatively uncommon; the aggregate incidence is estimated at 0.8 to 1.2 per 100 000 in the US population. These aspects of disease make SGCA both a clinical and epidemiological challenge. In the past decade there has been increasing interest in the role that race and ethnicity play in cancer survival. Whereas several studies have documented disparities in head and neck cancer outcomes for black patients in the United States, few studies have evaluated the effect that race and ethnicity have on disease-specific survival for patients with SGCA. We therefore conducted this study with the primary objective of determining whether racial and/or ethnic disparities exist for SGCA survival.

Methods

Data Source
Completely deidentified data for all cases of SGCA for the years 1988 to 2010 were acquired from the National Cancer Institute’s Surveillance, Epidemiology, and End Results (SEER) database on limited-use terms. Institutional review board review and informed consent were not required because the data were deidentified prior to our interaction with the data. The follow-up cutoff date for the November 2012 submission used in this analysis was December 31, 2010. The flowchart for the cohort selection is shown in Figure 1. Patients whose diagnosis was made at death or autopsy and those with incomplete demographic information were excluded from the analysis. Patients were also excluded if the SGCA was not the patient’s first cancer. Included primary sites as defined by the American Joint Committee on Cancer were identified by the following site codes: Parotid Gland (C079), Submandibular Gland (C080), Sublingual Gland (C081), Overlapping Lesion of Major Salivary Glands (C088), and Major Salivary Gland Not Otherwise Specified (C089). Histology codes were based on the SEER Histology Recode–Broad Groupings: epithelial, not otherwise specified (NOS) (01); squamous cell (02); adenomas and adenoscarcinomas (05); mucoepidermoid neoplasms (07); cystic, mucinous, and serous (08); ductal and lobular (09); acinar cell (10); complex epithelial (11); complex mixed and stromal (21). Information for a unique patient identifier, sex, age at diagnosis, year of diagnosis, sequence number, tumor size, tumor extension, lymph node involvement, surgical treatment, radiation use and method, race, Hispanic ethnicity, survival time, cause of death, vital status at last follow-up, histologic subtype, grade, and source of report were extracted for each case. These parameters were determined by the following SEER variables: Patient ID number, Sex, Age at Diagnosis, Year of Diagnosis, Sequence Number–Central, EOD–Tumor Size, CS Tumor Size, EOD–Extension and CS Extension, EOD–Lymph Node Involv and CS Lymph Nodes, RX Summ–Surg Prim Site and RX Summ–Surgery Type, RX Summ–Radiation, Race Recode (W, B, AI, API [white, black, American Indian, Asian or Pacific islander]), Origin Recode NHIA (North American Association of Central Cancer Registries Hispanic/Latino Identification Algorithm) (Hispanic, Non-Hispanic), Survival Months, Cause of Death to SEER Site Recode, Vital Status Recode, Histology Recode–Broad Groupings, Grade, and Type of Reporting Source, respectively.

Data Analysis
Data extraction and preparation were performed in SAS, version 9.3 (SAS Institute). Patients were separated into 3 racial...
and/or ethnic groups as white, black, and Hispanic. Histologic groups were classified as mucoepidermoid carcinoma, adenocarcinoma, adenoid cystic carcinoma, squamous cell carcinoma, acinar cell carcinoma, and other malignant histologic subtypes. For tumor characteristics, tumor grade was reclassified as either low or high. The low-grade group included tumors reported as grade 1, grade 2, well differentiated, moderately differentiated, and with intermediate differentiation. The high-grade group included tumors reported as grade 3, grade 4, poorly differentiated, undifferentiated, and anaplastic. Extension was reclassified as intraglandular, extraglandular, or metastatic. Lymph node involvement was reclassified into either no lymph node involvement or positive nodes. In addition, for treatment characteristics, surgery and radiation therapy were dichotomized into yes or no.

All statistical analyses and figure generation were performed in R and SAS, version 9.3. Comparisons of Kaplan-Meier survival estimates for white, black, and Hispanic populations were performed using the log-rank test, and confidence intervals (CIs) were calculated using the log-transform method. For further investigating the magnitude of disparity in survival between racial groups, Cox regression models were built to provide hazard ratios (HRs) with accompanying 95% CIs for minority (Hispanic or black) vs white by controlling for patient characteristics (model 2), patient and tumor characteristics (model 3), and patient, tumor, and treatment characteristics (model 4) for all histologic subtypes. When the number of events (death from SGCA) was adequate for analysis, a separate set of Cox regression models were built for each of the individual SGCA histologic subtypes. \( P < .05 \) was considered statistically significant.

**Results**

Overall, 11,007 patients met criteria for inclusion in the study. Of these, 8866 (80.55%), 1073 (9.75%), and 1068 (9.70%) were white, black, and Hispanic, respectively (see Table 1). In the white population, 59.26% of patients were male, compared with 48.09% and 48.88% in the black and Hispanic populations, respectively (\( P < .001 \)). Notably, the mean age at diagnosis for whites was 62.57 years, compared with 53.01 and 52.34 years for blacks and Hispanics, respectively (\( P < .001 \)). Mean tumor size (greatest dimension) at diagnosis for whites (29.17 mm) was smaller than in blacks (33.47 mm) and Hispanics (31.23 mm; \( P < .001 \)). Examination of tumor grade revealed a larger proportion of high-grade tumors in whites (33.03%) than in blacks (24.31%) and Hispanics (20.69%; \( P < .001 \)). Whites had the greatest proportion of patients with positive lymph nodes (32.06%), whereas blacks were intermediate (27.66%) and Hispanics had the least (24.58%; \( P < .001 \)). eTables 1 through 5 (in Supplement) show how these characteristics are distributed for the individual SGCA histologic subtypes. For all SGCA histologic subtypes combined, unadjusted Kaplan-Meier 5-year survival rates for whites, blacks, and Hispanics were 89%, 88%, and 95%, respectively, and 78%, 79%, and 81%, respectively, for 20-year survival (Table 2 and Figure 2). The log-rank test was used to compare the unadjusted survival curves, revealing that blacks had no significant difference in disease-specific survival compared with whites (\( P = .18 \)), whereas Hispanics had significantly better disease-specific survival than whites (\( P = .003 \)).

The multivariable Cox regression models provide further insight as to how patient, tumor, and treatment characteristics affect disease-specific survival in whites, blacks, and Hispanics for all SGCA histologic subtypes combined (Table 3). The models were built starting with the crude, unadjusted model (model 1), then progressed to controlling for patient characteristics (age and sex; model 2), then to controlling for patient characteristics and tumor characteristics (histologic subtype, tumor grade, tumor size, extension, and lymph node status; model 3), and finally to controlling for patient characteristics, tumor characteristics, and treatment characteristics (surgery and radiation; model 4). For all SGCA histologic subtypes, the unadjusted Cox model (model 1) showed the same results as the unadjusted Kaplan-Meier estimates: no significant difference in disease-specific survival for blacks compared with whites (HR, 0.97; \( P = .74 \)) but an apparent survival advantage for Hispanics compared with whites (HR, 0.70; \( P = .001 \)). However, when patient age and sex were controlled for (model 2), there was no significant difference in disease-specific survival for Hispanics compared with whites (HR, 0.97; \( P = .76 \)), and a statistically significant worse disease-specific survival for blacks compared with whites (HR, 1.34; \( P = .001 \)) was revealed. Controlling for tumor characteristics in addition to patient characteristics (model 3) and for patient, tumor, and treatment characteristics (model 4) yielded similar results to model 2: no significant difference in disease-specific survival between Hispanic and white patients but a statistically significant worse disease-specific survival for black compared with white patients (Table 3). In addition, older age at diagnosis, higher tumor grade, larger tumor size, extraglandular or metastatic extension, positive lymph nodes, and no surgical treatment each had a statistically significant detriment on survival for all patients.

We next analyzed the survival data by individual SGCA histologic subtypes. For patients with mucoepidermoid carcinoma, unadjusted Kaplan-Meier 5-year survival rates for whites, blacks, and Hispanics were 89%, 88%, and 95%, respectively, and 87%, 88%, and 93%, respectively, for 20-year survival (Table 2 and Figure 2). Using the log-rank test to compare the unadjusted survival curves, blacks had no significant difference in disease-specific survival compared with whites (\( P = .35 \)), whereas Hispanics had significantly better disease-specific survival than whites (\( P = .02 \)). The unadjusted Cox model (eTable 6 in Supplement, model 1) for mucoepidermoid carcinoma also showed no significant difference in disease-specific survival between black and white patients and an apparent survival advantage for Hispanic compared with white patients. Controlling for patient age and sex (model 2) showed no significant difference in disease-specific survival for black compared with white patients and eliminated the apparent survival advantage for Hispanic compared with white patients. However, in model 2 (patient characteristics) and model 3 (patient and tumor characteristics), black patients had statistically insignificant
poorer disease-specific survival compared with white patients. As the analysis progressed to the point of controlling for patient, tumor, and treatment characteristics (model 4), in comparison with white patients, there remained no statistical difference in disease-specific survival for Hispanic patients (HR, 0.76; \(P = .36\)), but black patients had statistically significant worse survival (HR, 1.56; \(P = .03\)).

For patients with adenocarcinoma, unadjusted Kaplan-Meier 5-year survival rates for whites, blacks, and Hispanics were 74%, 74%, and 81%, respectively, and 67%, 69%, and 77%, respectively, for 15-year survival (Figure 2 and Table 2). There were an insufficient number of cases to calculate reliable 20-year survival rates for black or Hispanic patients. When the log-rank test was used to compare the unadjusted survival curves, there was no statistically significant difference in disease-specific survival between black and white patients (\(P = .82\)) or Hispanic and white patients (\(P = .36\)). The multivariable Cox regression analysis presented in eTable 7 (in Supplement) shows that when patient, tumor, and treatment characteristics were controlled for, there remained no statistically significant difference in disease-specific survival for Hispanic compared with white patients (HR, 0.88; \(P = .58\)) or black compared with white patients (HR, 1.15; \(P = .45\)).

For patients with adenoid cystic carcinoma, unadjusted Kaplan-Meier 5-year survival rates for whites, blacks, and Hispanics were 67%, 69%, and 77%, respectively, for 15-year survival (Figure 2 and Table 2). There were an insufficient number of cases to calculate reliable 20-year survival rates for black or Hispanic patients. When the log-rank test was used to compare the unadjusted survival curves, there was no statistically significant difference in disease-specific survival between black and white patients (\(P = .82\)) or Hispanic and white patients (\(P = .36\)). The multivariable Cox regression analysis presented in eTable 7 (in Supplement) shows that when patient, tumor, and treatment characteristics were controlled for, there remained no statistically significant difference in disease-specific survival for Hispanic compared with white patients (HR, 0.88; \(P = .58\)) or black compared with white patients (HR, 1.15; \(P = .45\)).
Hispanics were 89%, 91%, and 89%, respectively, and 75%, 72%, and 76%, respectively, for 20-year survival (Table 2 and Figure 2). There was no statistically significant difference in disease-specific survival between black and white patients (P > .99) or Hispanic and white patients (P = .99). The multivariable Cox regression analysis presented in eTable 8 (in Supplement) shows that when patient, tumor, and treatment characteristics were controlled for, there remained no statistically significant difference in disease-specific survival for Hispanic compared with white patients (HR, 1.05; P = .049). When the log-rank test was used to compare the adjusted survival curves, blacks had no significant difference in disease-specific survival compared with whites (P = .05). However, the unadjusted Cox model (eTable 9 in Supplement, model 1) for squamous cell carcinoma showed no significant difference in disease-specific survival between Hispanic and white patients but a statistically significant worse disease-specific survival for black compared with white patients. As the analysis progressed through the Cox models to control for patient characteristics (model 2), patient and tumor characteristics (model 3), and patient, tumor, and treatment characteristics (model 4), the results of equivalent disease-specific survival for Hispanic and white patients but statistically significant worse disease-specific survival for black compared with white patients were maintained, although in model 4, the result for black compared with white patients became statistically nonsignificant (HR, 1.58; P = .05).

For patients with acinar cell carcinoma, unadjusted Kaplan-Meier 5-year survival rates for whites, blacks, and Hispanics were 81%, 70%, and 69%, respectively, for 15-year survival (Figure 2 and Table 2). There were an insufficient number of cases to calculate reliable 20-year survival rates for Hispanic patients. When the log-rank test was used to compare the unadjusted survival curves, there was no statistically significant difference in survival between black and white patients (P = .09) or Hispanic and white patients (P = .35). However, the unadjusted Cox model (eTable 9 in Supplement, model 1) for squamous cell carcinoma showed no significant difference in disease-specific survival between Hispanic and white patients but a statistically significant worse disease-specific survival for black compared with white patients. As the analysis progressed through the Cox models to control for patient characteristics (model 2), patient and tumor characteristics (model 3), and patient, tumor, and treatment characteristics (model 4), the results of equivalent disease-specific survival for Hispanic and white patients but statistically significant worse disease-specific survival for black compared with white patients were maintained, although in model 4, the result for black compared with white patients became statistically nonsignificant (HR, 1.58; P = .05).

For patients with acinar cell carcinoma, unadjusted Kaplan-Meier 5-year survival rates for whites, blacks, and Hispanics were 95%, 97%, and 99%, respectively, and 91%, 94%, and 92%, respectively, for 20-year survival (Table 2 and Figure 2). When the log-rank test was used to compare the unadjusted survival curves, blacks had no significant difference in disease-specific survival compared with whites (P = .13), whereas Hispanics had statistically significant better disease-specific survival than whites (P = .049). When multivariable Cox regression modeling was attempted for this histologic subgroup, because of the high survival rates for all patient groups, the proportion of censoring was as high as 93% and the standard error on the parameter estimates was too wide, which raised concern for the validity of...
any results obtained from the modeling; therefore, multivariable analysis was not performed for acinar cell carcinoma. However, given that such an analysis was prevented by very good survival in all racial and/or ethnic groups with this SGCA histologic subtype, any disparity in survival would likely be small.

**Discussion**

Significant disparities in survival have been demonstrated for black patients with cancers of the head and neck within the past decade.\(^2\)\(^-\)\(^5\) Molina and colleagues\(^2\) found that for all locations of squamous cell carcinoma of the head and neck, median survival time for black patients was significantly shorter (21 months) than for white patients (40 months; \(P < .001\)). Likewise, Nichols and Bhattacharyya\(^3\) demonstrated that for glottic squamous cell carcinoma, both mean overall survival and disease-specific survival were significantly worse in black patients compared with matched white controls. The authors of these studies found that a large portion of the disparity in survival for black patients is explained by more advanced disease at presentation, poorer socioeconomic status, comorbidities, and less surgical treatment.\(^2\)\(^-\)\(^3\) However, even when these variables are controlled for, poorer survival persisted in the black populations, leading the authors to speculate that other environmental, and perhaps genetic, factors play a role in the survival disparity.\(^2\)\(^-\)\(^3\)

Although numerous studies\(^6\)-\(^15\) in the literature have evaluated prognostic factors in SGCA survival, few\(^6\),\(^14\),\(^15\) have evaluated the role that race and ethnicity play in survival in these cancers. In 1984, Spitz and Batsakis\(^6\) noted improved overall survival for black patients compared with white patients in their study of 498 patients with SGCA from their institution; however, this finding was not subjected to multivariate analysis; in addition, no meaningful comparisons of survival could be made for Hispanic patients because only 7 of the 498 patients were Hispanic. In 2011, Cheung and colleagues\(^14\) found that race and ethnicity had no effect (as determined by multivariable Cox regression analysis) on overall survival in a study of 968 patients with SGCA from a Florida cancer registry; this study included Hispanic patients and data on individual patient comorbidities. In 2012, Ellington and colleagues\(^15\) studied incidence and survival trends for adenoid cystic SGCA in 3026 patients from the SEER database from 1973 to 2007; multivariable Cox regression models showed that race (defined as white, black, or other) had no effect on observed survival; ethnicity was not addressed in the study.

Given the sparse literature on the topic, we conducted this study to determine whether racial and/or ethnic disparities exist for SGCA survival. To our knowledge, this is the

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**Figure 2. Kaplan-Meier Estimates for Disease-Specific Survival**

A-F, Kaplan-Meier estimates of disease-specific survival for white, black, and Hispanic patients. The survival probability and the corresponding 95% confidence interval are represented by solid lines and dashed lines, respectively.
first study to examine racial and ethnic disparities in SGCA survival as the primary objective, and it is the largest study to date to examine effects of race and/or ethnicity on SGCA survival when studies that have addressed race and/or ethnicity as a prognostic factor are considered. Overall, when all SGCA histologic subtypes are examined together, our results show that there is an apparent survival advantage in SGCA for Hispanic patients compared with white

Table 3. Multivariable Cox Regression Modeling Analysis on Survival Disparities of Race and/or Ethnicity for All Histologic Subtypes of Salivary Gland Cancer

<table>
<thead>
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<th>Variable</th>
<th>Modelb</th>
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<td>1 HR (95% CI)</td>
<td>P Value</td>
<td>2 HR (95% CI)</td>
<td>P Value</td>
<td>3 HR (95% CI)</td>
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<td>Race and/or ethnicity</td>
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<tr>
<td>Hispanic</td>
<td>0.70 (0.58-0.86)</td>
<td>.001</td>
<td>0.97 (0.79-1.19)</td>
<td>.76</td>
<td>0.94 (0.77-1.15)</td>
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<td>Black</td>
<td>0.97 (0.82-1.15)</td>
<td>.74</td>
<td>1.34 (1.13-1.60)</td>
<td>.001</td>
<td>1.29 (1.08-1.54)</td>
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<td>Sex</td>
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<tr>
<td>Female</td>
<td>0.73 (0.65-0.81)</td>
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<td>1.00 (0.90-1.12)</td>
<td>.94</td>
<td>1.00 (0.89-1.11)</td>
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<tr>
<td>&gt;49-65</td>
<td>2.19 (1.84-2.61)</td>
<td>&lt;.001</td>
<td>1.46 (1.22-1.74)</td>
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<td>1.40 (1.17-1.67)</td>
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<td>&gt;65-75</td>
<td>3.43 (2.87-4.10)</td>
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<td>2.11 (1.76-2.53)</td>
<td>&lt;.001</td>
<td>2.03 (1.69-2.44)</td>
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<td>&gt;75</td>
<td>4.92 (4.13-5.85)</td>
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<td>2.76 (2.31-3.31)</td>
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<td>2.58 (2.15-3.09)</td>
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<tr>
<td>Adenocarcinoma</td>
<td>1.52 (1.28-1.80)</td>
<td>&lt;.001</td>
<td>1.47 (1.24-1.74)</td>
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<tr>
<td>Adenoid cystic carcinoma</td>
<td>1.16 (0.93-1.44)</td>
<td>.19</td>
<td>1.11 (0.89-1.34)</td>
<td>.36</td>
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<td>Squamous cell carcinoma</td>
<td>0.95 (0.80-1.14)</td>
<td>.60</td>
<td>0.85 (0.71-1.01)</td>
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<td>Acinar cell carcinoma</td>
<td>0.69 (0.52-0.92)</td>
<td>.01</td>
<td>0.75 (0.56-0.99)</td>
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<td>Other malignant histologic subtype</td>
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<td>.002</td>
<td>1.21 (1.02-1.44)</td>
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<td>Tumor gradec</td>
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<tr>
<td>High</td>
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<td>2.22 (1.87-2.63)</td>
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<td>Tumor size, mm°C</td>
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<td>&gt;17-25</td>
<td>1.78 (1.41-2.24)</td>
<td>&lt;.001</td>
<td>1.75 (1.39-2.21)</td>
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<td>&gt;25-37</td>
<td>2.14 (1.70-2.70)</td>
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<td>2.07 (1.65-2.61)</td>
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<td>&gt;37</td>
<td>3.03 (2.43-3.78)</td>
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<td>2.74 (2.19-3.41)</td>
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<td>Extensionc</td>
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<td>Intraglandular</td>
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<tr>
<td>Extraglandular</td>
<td>2.55 (2.24-2.91)</td>
<td>&lt;.001</td>
<td>2.40 (2.11-2.74)</td>
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<tr>
<td>Metastatic</td>
<td>6.29 (5.09-7.77)</td>
<td>&lt;.001</td>
<td>4.29 (3.43-5.36)</td>
<td>&lt;.001</td>
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<td>Lymph nodesc</td>
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<td>Positive</td>
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<td>2.27 (2.00-2.57)</td>
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<td>Surgery</td>
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<td>No</td>
<td>2.66 (2.32-3.06)</td>
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Abbreviation: HR, hazard ratio.

* In Cox regression analysis, only patients with complete treatment characteristics were considered (n = 10 745). Age at diagnosis and tumor size (greatest dimension) were divided into quartiles. For age at diagnosis, the upper limit of the second quartile, 62, was replaced by 65. Except for model 1 (crude model), diagnosis year was included into the models (not shown).

b When the Cox regression models were fitted, the assumption of proportionality was assessed by the significance of a term of the predictor associated with the logarithm of survival time, and an appropriate stratified analysis was adopted if needed. In model 2 (patient characteristics) and model 3 (patient and tumor characteristics), there were no violations of this assumption. In model 4 (patient, tumor, and treatment characteristics), a severe violation appeared on radiotherapy (yes/no) and a stratified Cox model on radiotherapy was built; therefore, although not shown, radiotherapy is included in model 4.

c For the analyses for all models with the same number of patients, the patients with unknown tumor grade, tumor size, extension, or lymph nodes were included.
patients that is explained entirely by younger age at diagno-
sis, whereas for black patients compared with white pa-
tients, there is an underlying statistically significant worse
survival for SGCA that is revealed by controlling for patient
characteristics (age and sex) and maintained when tumor
and treatment characteristics are additionally controlled for
(Table 3).

Looking more closely at the survival data for the indi-
vidual SGCA histologic subtypes (Table 2, eTables 6–9 in Supple-
ment), we see that this disparity is driven by poorer disease-
specific survival for black patients with mucoepidermoid
(eTable 6 in Supplement) and squamous cell (eTable 9 in
Supplement) carcinomas. However, the nature of the dispar-
ity differs between these 2 SGCA subtypes. For mucoepider-
moid carcinoma, whereas statistically insignificant results
showing worse disease-specific survival were noted as pa-
tient and patient and tumor variables were controlled for
(eTable 6 in Supplement, models 2 and 3), a statistically sig-
ificant poorer disease-specific survival for black patients was
not observed until patient, tumor, and treatment variables (sur-
gery and radiation, model 4) were controlled for, indicating
that the poorer survival for black compared with white patients with
mucoepidermoid carcinoma is due to other variables that were
not controlled for. This is in contradistinction to the pattern
that we see for squamous cell carcinoma, in which the unad-
justed Cox model (eTable 9 in Supplement, model 1) shows a
baseline statistically significant poorer disease-specific sur-
vival for black compared with white patients. As we progress
through the Cox models for squamous cell carcinoma, con-
trolling for patient, tumor, and treatment variables, this poorer
disease-specific survival for black compared with white pa-
tients is maintained until treatment variables are added (sur-
gery and radiation, model 4). At this point, the difference in
disease-specific survival becomes statistically nonsignifi-
cant, implying that the poorer survival for black compared with
white patients with squamous cell carcinoma is largely due to
differences in treatment regimens between the 2 groups. As
shown in eTable 4 (in Supplement), the difference is that black
patients received significantly less surgical treatment than
white patients (57.26% vs 76.94%; P < .001); this finding is con-
sistent with several previously published studies on racial dis-
parities in survival from squamous cell carcinoma of the head
and neck.2–4 However, it remains possible that other factors be-
yond those that we controlled for contributed to the ob-
served survival disparity.

The recent study by Cheung and colleagues14 provides
additional insight into possible sources of the poorer disease-
specific survival for black patients demonstrated in our
study. The data set in their study was obtained from the
Florida Cancer Data System, which contains chemotherapy
data in addition to surgery and radiation treatment data; in
their study, the Florida Cancer Data System was also linked to
the Florida Agency for Health Care Administration to obtain
data on patient comorbidities and, ultimately, through the US
Census Bureau, data on community poverty levels for the
patients. Therefore, whereas Cheung and colleagues14 found
that race and ethnicity had no effect on survival, unlike our
study, they were able to control for patient comorbidities,
poverty level, and chemotherapy treatment, which implies
that the source of survival disparity for black patients com-
pared with white patients seen in our study could be due to
differences in chemotherapy treatment, comorbidities, and/or
poverty levels. Whereas this comparison is helpful for
potentially directing future research, it is not conclusive
because their study and ours are not directly comparable—
their study evaluated overall survival whereas ours evalu-
ated disease-specific survival, a key distinction. It would be
expected that comorbidities would have a greater impact on
overall survival than on disease-specific survival, with an
important exception being those cases in which the pres-
cence of certain comorbidities influenced treatment deci-
sions, which would then allow comorbidities to indirectly
influence disease-specific survival. The larger data set in
our study also provides increased power to detect smaller
differences.

Tumor genetic factors are another potential source for
the poorer disease-specific survival for black compared with
white patients in our study. Within the last 2 years, it has
been shown that overexpression and increased gene copy
number of EGFR and HER2 are correlated with high tumor
grade and unfavorable survival for patients with SGCA.16–17
In addition, gain or loss of MET gene copies and PTEN dele-
tions correlate strongly with high tumor grade, increased
rate of lymph node metastases, and poorer overall survival
in SGCA.18,19 PTEN deletions are also strongly correlated with
increased EGFR and HER2 expression and are potentially
responsible for the poor response that has been observed when anti-EGFR and anti-HER2 therapies are used
to treat patients with SGCA who have increased EGFR and
HER2 expression.19 We have previously shown that the dis-
pparity in survival for black compared with white patients
with squamous cell carcinoma of the head and neck can be
explained entirely by a greater proportion of human
papillomavirus-negative disease in the oropharynx for black
compared with white patients.5 It is therefore tempting to
speculate that genetic variations in EGFR, HER2, MET, and
PTEN in SGCA between black and white populations could
explain at least some of the survival disparities that we
observed in the present study; additional research is war-
ranted in this area.

Finally, environmental exposures are also a possible
source for the poorer disease-specific survival for black
patients in our study. Looking at differences in occupational
exposures between black and white patients with SGCA, Wil-
son and colleagues20 performed a case-control study in 2004
of 2505 patients to evaluate possible risk factors for death of
SGCA. Some of their notable findings included increased risk
of death of SGCA for black female cooks (odds ratio [OR], 6.0
[95% CI, 1.47–24.13]), black male janitors (OR, 2.2 [95% CI,
1.01–4.6]), white female food service supervisors (OR, 6.7
[95% CI, 1.86–23.79]), and white male architects (OR, 5.2
[95% CI, 1.38–19.60]). Interestingly, in contrast to black male
janitors, white male janitors experienced decreased risk of
death of SGCA (OR, 0.6 [95% CI, 0.41–0.87]). Looking more
closely at the differences between black and white male jani-
tors, the authors found that approximately half (49%) of
black male janitors were employed in manufacturing industries, whereas almost all (97%) white male janitors were employed in industries related to professional services and public administration, suggesting that differences in occupational exposures exist according to race, which could translate into differences in SGCA survival according to race.

This study has several important limitations that one must consider when interpreting the results. Whereas the SEER database provides the opportunity to study even rare diseases at the population level, it lacks data on chemotherapy, has a limited description of the character of surgical and radiation treatments, and includes data from many institutions. Therefore, our results could be biased by different racial and ethnic groups attending different institutions and/or receiving differing types or qualities of treatment that are coded as identical. Furthermore, the SEER database does not contain data on comorbidities, occupation, or socioeconomic status.

Conclusions

Our results show that for patients with a diagnosis of SGCA, black race is a risk factor for poorer disease-specific survival for those with mucopidermoid or squamous cell carcinoma, whereas Hispanic ethnicity has no effect on disease-specific survival for any SGCA histologic subtype. Differences in treatment regimens between black and white patients—particularly, less surgical treatment for black patients—play a significant role in the disparity in squamous cell SGCA survival for black compared with white patients but not in the disparity in mucopidermoid SGCA survival. Differences in chemotherapy treatment, comorbidities, socioeconomic status, tumor genetic factors, and environmental exposures are potential but unproven additional sources of the racial survival disparities for mucopidermoid and squamous cell SGCA, indicating the need for additional research into each of these areas.

REFERENCES