Racial disparity in stage at diagnosis and survival among adults with oral cancer in the US

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Abstract – *Objectives:* To explore distribution of stage at diagnosis and relative survival rates among US adults with oral cavity cancer in relation to race, and over time. *Methods:* We obtained 1973–2002 oral cancer incidence data from the Surveillance, Epidemiology, and End Results (SEER) Program, and computed proportions for each oral cavity site by stage at diagnosis, tumor size, and 5-year relative survival rates among Whites and Blacks. *Results:* A total of 46 855 cases of oral cavity cancer were reported to the SEER registry among adults ≥20 years between 1973 and 2002. African–Americans had a significantly higher proportion of cancer, mainly in the tongue, that had spread to a regional node or to a distant site at diagnosis than Whites: 67% versus 49% of tongue cancers reported from 1973 to 1987 ($P < 0.001$), and 70% versus 53% of those reported from 1988 to 2002 ($P < 0.001$). They had a significantly higher proportion of tongue cancer that were >4 cm in diameter at time of diagnosis (59% versus 44%; $P < 0.001$), and black men in particular experienced lower 5-year relative survival rates than white men, in particular, for tongue cancer (25% versus 43% from 1973 to 1987, and 31% versus 53% from 1988 to 2002). *Conclusion:* There are significant racial disparities with respect to stage at diagnosis and survival among adults with oral cancer reported to the SEER registry from 1973 to 2002. One possible explanation for the lower survival among Blacks may be a difference in access to, and utilization of, healthcare services.

Racial disparities between African–Americans and Caucasians with respect to health outcomes have been widely reported in the literature, in particular with respect to cancer (1–10). For example, black women with breast cancer have been found to be more likely to be diagnosed after a patient-noted abnormality than white women, who are more likely to be diagnosed following a mammogram (2). An extensive review on racial and ethnic disparities uncovered that black women underwent mastectomy than breast-conserving surgery more frequently than white women (3). This review also found that racial/ethnic minorities were consistently found to have less frequently undergone appropriate surgical resection for lung and colorectal cancers than Whites.

Between 1992 and 2001, cancer of the oral cavity and pharynx was the fourth most common cancer and ranked 10th among the most common causes of death in African–American men, while it was the eighth most common cancer among Caucasian–American men (11). Oral cavity cancer can be diagnosed at an early stage by a routine visual inspection of the mouth. Stage at diagnosis of oral cancer is critically important as it guides treatment and is the single most important predictor of outcome. Large size of tumor, spread to regional lymph nodes, and presence of metastases in distant organs have been found to be closely related to poor survival (12–15). Therefore, it is critical to identify subgroups at higher risk for delayed diagnosis in an effort to develop screening

strategies that will target them. Studies have uncovered differences in oral and pharyngeal cancer rates and trends in North Carolina 1990–1999 (16) and treatment and survival in Florida 1988–1998 (17). The objective of the present analysis was to explore the distribution of stage at diagnosis and relative survival rates in a larger population of adults with oral cavity cancer (assumed to be representative of the US population) in relation to race over a longer period of time, using the 1973–2002 database from the Surveillance Epidemiology and End Results (SEER) program (18).

Methods

Data source and variables

We obtained the 1973–2002 oral cancer incidence data from the SEER Program (18). This Program was established by the National Cancer Institute in 1973, in response to the 1971 National Cancer Act and initially collected data from population-based cancer registries in nine geographic areas that together represented an estimated 10% of the US population: five states (Connecticut, Hawaii, Iowa, New Mexico, and Utah) and four standard metropolitan statistical areas (Atlanta, Detroit, San Francisco–Oakland, and Seattle–Puget Sound). The SEER Program was subsequently expanded, and since 1992 it collects data from population-based cancer registries in 13 geographic areas that together represent an estimated 26% of the US population. The completeness of reporting of cancer cases to the SEER Program has been estimated as 97% for six of the geographic areas (19). The SEER registry includes data on patient demographics, primary tumor site, morphology/histology, stage at diagnosis, and first course of treatment. Information on vital status is actively followed. For the present analysis, we used the SEER 9 registries 1973–2002 database (18) (as we were interested in performing trend analyses over the entire 29-year period), and we extracted data as regards the following cases: adults 20 years or older, with invasive cancer (no *in situ* cases) affecting the oral cavity. Salivary gland cancers were excluded because the histology of these tumors differs from that of the mouth where the vast majority of cancers (over 85%) are squamous cell carcinomas. In the SEER database, oral cavity sites are grouped as lip, tongue, floor of mouth (FOM), and 'other mouth' (gingiva/palate/buccal mucosa/vestibule).

Statistical analysis

We used the SEER*Stat version 6.2.1. software (18) and STATA version 8.0 (20) for the analyses presented in this report. Counts and proportions of cancers of the oral cavity were summarized by race in relation to age group and specific site. We computed proportions for each site by stage at diagnosis (localized versus spread to regional lymph nodes or to a distant site), among Whites and Blacks (which were the two predominant racial groups), and by time period: we divided the entire time period in two 15-year time periods, 1973–1987 and 1988–2002. We used the chi-squared test to compare Blacks and Whites with respect to stage at diagnosis (localized versus spread) for each site. We computed the proportion of cases for each site by size of tumor (diameter) at time of diagnosis (categorizing tumors as <2 cm, 2–4 cm, and >4 cm), and used the chi-squared test to compare Blacks and Whites. We used the life-table method to compute survival rates. The 5-year relative survival rate is defined as the likelihood that a person will not die of cancer (or related cause) 5 years after the date of diagnosis (21, 22). We computed 5-year relative survival rates in both Whites and Blacks by gender and by specific site, for the two time periods, 1973–1987 and 1988–2002. We also explored the 5-year relative survival rates for persons with tongue cancer among Whites and Blacks by gender, stage at diagnosis, and age group (20–44 years versus ≥45 years).

We estimated incidence rates, defined as the number of new cases per 100 000 persons, by race/ethnicity and gender. When relevant, rates were age-adjusted to the 2000 US standard million population. We computed the percent change (PC) and the estimated annual percent change (EAPC) from 1973 to 2002. The EAPC is computed by fitting a least squares regression line to the natural logarithm of the rates, using calendar year as a regressor variable (21, 22). Testing the hypothesis that the EAPC = 0 is equivalent to testing the hypothesis that the regression parameter is equal to zero. The hypothesis is rejected at a significance level of $P < 0.05$.

Results

Distribution of oral cancer cases by race, age, and site

A total of 46 855 cases of oral cancer were reported to the SEER registry between 1973 and 2002. The

Table 1. Distribution of oral cavity cancer cases reported to the SEER Program 1973–2002 by race, age, and site

	All races, n (%)[a]	Whites, n (%)[a]	Blacks, n (%)[a]	Other races, n (%)[a]
Age (years)				
20–44	4037 (9)	3230 (8)	542 (14)	207 (13)
45–54	7696 (16)	6257 (15)	1155 (30)	228 (14)
55–64	12555 (27)	10950 (27)	1180 (30)	376 (23)
≥65	22567 (48)	20646 (50)	1020 (26)	1631 (50)
Site				
Tongue	16021 (34)	13608 (33)	1583 (41)	778 (48)
Floor of mouth	7691 (16)	6544 (16)	883 (23)	238 (15)
Gingiva/palate/buccal mucosa/vestibule	13241 (28)	11271 (27)	1368 (35)	550 (34)
Lip	9902 (21)	9660 (24)	63 (2)	65 (4)
Total	46855[b]	41083 (88)[c]	3897 (8)[c]	1631 (4)[c]
2000 US Census (%)		(75)	(12)	(13)

[a]Column percentage values may not add to 100 due to rounding.
[b]The total number of cases includes 244 cases with unknown race status.
[c]Row percentage values based on 46 611 cases with known race status.

majority of oral cancer cases (75%) were diagnosed in persons ≥55 years of age while 9% of cases were in young adults, 20–44 years old (Table 1). The distribution of cases by racial groups differed from the 2000 US Census mainly in the proportion of Whites that was slightly higher among oral cancer cases reported to the SEER Program from 1973 to 2002 than the proportion of Whites in the general population (88% versus 75%). The most common site affected in all racial groups was the tongue (34% of cases), with the highest proportion found among non-Whites (41% in Blacks and 48% in other non-White races). The lip was the least common site in Blacks and other non-White groups (2% and 4%, respectively), while it represented a quarter of all oral cavity cancers among Whites.

Trends in oral cancer incidence over time
The age-adjusted incidence rate of oral cancer among white men decreased from 20.7/100 000 to 13.3/100 000 from 1973 to 2002 ($P < 0.001$; Fig. 1a). Similarly, during that time period, the age-adjusted incidence rate among black men decreased from 16.5/100 000 to 11.2/100 000 ($P < 0.001$; Fig. 1b). The age-adjusted incidence rates among women were almost one-third of those among men, but they decreased much less over time (from 6.1/100 000 in 1973 to 5.9/100 000 in 2002 among white women, and from 5.1/100 000 to 4.9/100 000 among black women; Fig. 1a,b).

Stage at diagnosis for oral cancer among white and black adults by site and over time
Among black adults with oral cancer, in 70% with cancer of the tongue and 63% with cancer of the floor of mouth reported to the SEER Program

between 1988 and 2002 had already metastasized to the regional lymph nodes or to a more distant site at the time of diagnosis (Table 2). By contrast, during the same time period, approximately 50% of white adults with cancer of the tongue or floor of mouth had tumors that had spread to regional nodes or metastasized at time of diagnosis. The difference between Blacks and Whites with respect to the proportion of cases having spread versus the proportion of localized cases was statistically significant for all sites, except the lip, and in both time periods. Furthermore, the proportion of oral cancer diagnosed at a more advanced stage between 1973 and 1987 was very similar to the proportion of such cases reported from 1988 to 2002 for most sites, suggesting no improvement over time with respect to early diagnosis of oral cancer.

Among black adults with oral cancer, nearly 60% of tongue cancers and half of the cancers of the floor of mouth were >4 cm in diameter at time of diagnosis (Table 3). Among Whites, 44% of tongue cancers and 40% of cancers of the floor of the mouth were also >4 cm in diameter at time of diagnosis. Cancers affecting the gingiva/palate/buccal mucosa/vestibule were also predominantly >4 cm in diameter when diagnosed (59% and 51% among Blacks and Whites, respectively). There was a statistically significant positive association between being Black and having a larger tumor size at diagnosis for each oral cavity site included in this analysis ($P < 0.001$).

Site-specific relative survival for white and black adults with oral cancer
The 5-year relative survival rate was only 25% for cancer of the tongue among black men in the
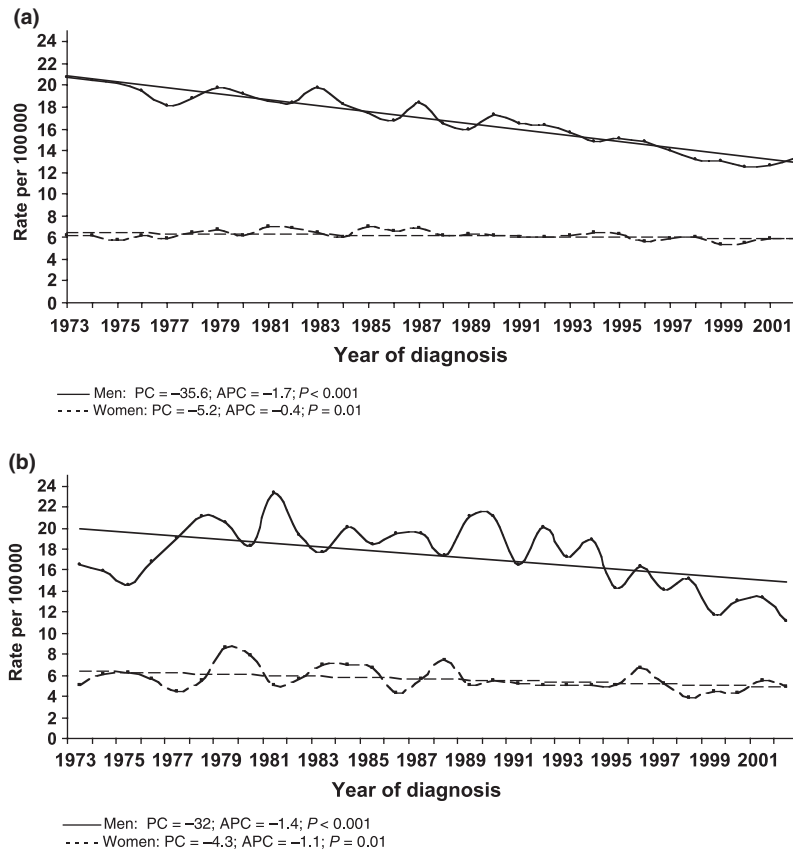
Fig. 1. (a) Trends in age-adjusted oral cancer incidence rates among white adults by gender, 1973–2002. (b) Trends in age-adjusted oral cancer incidence rates among black adults by gender, 1973–2002.

Table 2. Comparison by race and stage at diagnosis for site-specific oral cancer cases reported to the SEER Program 1973–2002

Site	1973–1987					1988–2002				
	n	Localized (%)	Spread[a] (%)	P-value[b]	Unstaged (%)	n	Localized (%)	Spread[a] (%)	P-value[b]	Unstaged (%)
Tongue										
Whites	5963	(41)	(49)	<0.001	(9)	7645	(41)	(53)	<0.001	(6)
Blacks	683	(26)	(67)		(7)	900	(21)	(70)		(9)
Floor of mouth										
Whites	3605	(41)	(50)	<0.001	(9)	2939	(43)	(51)	<0.001	(6)
Blacks	426	(29)	(64)		(7)	457	(29)	(63)		(8)
Gingiva/palate/buccal mucosa/vestibule										
Whites	5333	(35)	(51)	0.003	(15)	5938	(36)	(46)	<0.001	(18)
Blacks	613	(31)	(59)		(11)	755	(28)	(57)		(16)
Lip										
Whites	5476	(77)	(12)	0.4	(11)	4184	(78)	(14)	0.3	(8)
Blacks	29	(69)	(17)		(14)	34	(62)	(18)		(21)

[a]Spread to regional lymph nodes or to a more distant site.
[b]P-value for the chi-squared test used to compare the proportion of spread versus localized cases between Whites and Blacks.

1973–1987 time interval and 31% in the 1988–2002 period (Table 4). Similarly, <39% of black women were likely to be alive 5 years after their diagnosis of tongue cancer in either time period. The 5-year relative survival rate was almost twice as high in Whites than in Blacks however, it never exceeded 54% for any intra-oral cancer sites among white men in either time period. Overall, white women had the highest relative survival rates for intra-oral cancer. The lip was the only site with a higher 5-year relative survival rate in both Whites and Blacks. Among women with lip cancer, Blacks had a much lower survival rate than Whites (68% versus 95% in the 1988–2002 period); however, the

Table 3. Comparison of tumor size at time at diagnosis by race for site-specific oral cancer cases reported to the SEER Program 1973–2002

Site	Tumor size (diameter) at time of diagnosis			
	<2 cm n (%)[a]	2–4 cm n (%)[a]	>4 cm n (%)[a]	P-value[b]
Tongue				
Whites	2280 (30)	2025 (26)	3340 (44)	<0.001
Blacks	131 (15)	235 (26)	534 (59)	
Floor of mouth				
Whites	1005 (34)	760 (26)	1174 (40)	<0.001
Blacks	111 (24)	123 (27)	223 (49)	
Gingiva/palate/buccal mucosa/vestibule				
Whites	1547 (26)	1354 (23)	3037 (51)	<0.001
Blacks	144 (19)	166 (22)	445 (59)	
Lip				
Whites	2008 (48)	220 (5)	1956 (47)	<0.001
Blacks	10 (29)	8 (24)	16 (47)	

[a]Row percentage values may not add up to 100% due to rounding.
[b]P-value for chi-squared test used to compare Blacks and Whites with respect to tumor size.

Table 4. Five-year relative survival rates for persons with oral cancer by gender, race, and site; data from the SEER Program 1973–2002

	Tongue		Floor of mouth		Gingiva/palate buccal mucosa/ vestibule		Lip	
	n	5-year RS[a]	n	5-year RS	n	5-year RS	n	5-year RS
White men								
1973–1987	3341	0.43	2147	0.52	2522	0.50	4447	0.95
1988–2002	4034	0.53	1579	0.54	2450	0.52	2818	0.95
Black men								
1973–1987	434	0.25	289	0.37	334	0.37	16	0.78
1988–2002	552	0.31	278	0.31	399	0.32	13	0.82
White women								
1973–1987	1767	0.50	1006	0.65	1911	0.63	538	0.90
1988–2002	2016	0.59	728	0.60	1992	0.67	593	0.95
Black women								
1973–1987	162	0.37	80	0.49	183	0.61	11	0.74
1988–2002	188	0.38	94	0.56	210	0.63	11	0.68

[a]5-yr RS: 5-year relative survival defined as the likelihood that a person will not die from cancer-related causes 5 years after diagnosis.

lip cancer count among black women was so low ($n = 11$) that the 5-year relative survival estimate may not be reliable.

Relative survival in adults with tongue cancer by stage at diagnosis and age

When we explored survival rates in relation to stage at diagnosis for cases with tongue cancer we found that the 5-year relative survival rate ranged from 56%, among black men, to 71% among white women who had the highest rate, when the cancer was localized at time of diagnosis (Table 5). However, among cases of tongue cancer that had spread at time of diagnosis, the 5-year relative survival rate ranged from 21%, among black men, to 38% among white women.

Among young adults, 20–44 years old, the 5-year relative survival rates among white men and women with tongue cancer (62% and 69%, respectively) were more than twice the rates among black men and women (29% and 24%, respectively).

Discussion

Nearly 50 000 cases of oral cavity cancer have been reported to the SEER Program between 1973 and 2002. The tongue was the most common site

Table 5. Five-year relative survival rates for persons with tongue cancer by gender and race, and by stage at diagnosis and age; data from the SEER Program 1973–2002

| | Stage at diagnosis[a] | | | | Age | | | |
| | Localized | | Spread[b] | | 20–44 years | | ≥45 years | |
	n	5-year RS[c]	n	5-year RS	n	5-year RS	n	5-year RS
White men	2698	0.66	4189	0.37	718	0.62	6644	0.46
Black men	186	0.56	729	0.21	143	0.29	842	0.28
White women	1826	0.71	1701	0.38	353	0.69	3417	0.53
Black women	102	0.64	231	0.28	47	0.24	299	0.40

[a]Does not include cases with unknown staging.
[b]Spread to regional lymph nodes or to a more distant site.
[c]5-yr RS: 5-year relative survival defined as the likelihood that a person will not die from cancer-related causes 5 years after diagnosis.

affected in all races. African–Americans and other non-White races had a very small proportion of lip cancer (<5%), while nearly one quarter of all cancers were present in the lip in the Whites. While the trends in incidence rates over time were very similar among Blacks and Whites, there was a major difference between the two groups with respect to stage at diagnosis, tumor size at diagnosis, and 5-year relative survival rate. Black adults had significantly higher proportions of oral cavity cancer that had spread to a regional node or a more distant site at diagnosis than Whites for all sites except for the lip. They also had significantly higher proportions of tumors that were >4 cm in diameter at time of diagnosis and experienced much lower 5-year relative survival rates than Whites. When we explored the 5-year relative survival rate by stage at diagnosis for tongue cancer, it exceeded 55% in both Blacks and Whites of either gender among cases that were localized at time of diagnosis, but there was still a difference between Blacks and Whites among both men (56% versus 66%) and women (64% versus 71%). Among the cases of tongue cancer that were found to have already spread at time of diagnosis, survival was again lower among Blacks than among Whites (21% versus 37% among men, and 28% versus 38% among women). This confirms earlier analyses of the SEER data (1974–1986) by Kleinman et al. (21). Finally, we also found close to no improvement in either 5-year relative survival or in how early oral cancer was diagnosed in either Blacks or Whites between the earlier time period explored (1973–1987) and the more recent time period (1988–2002).

Racial disparity has been documented among African–Americans compared with Whites with respect to multiple health outcomes ranging from poorer pregnancy outcomes among women (23), to increased risk of graft failure among kidney transplant recipients (24), lower rates of hyperlipidemia treatment (25), and cancer, including oropharyngeal cancer (1–10, 16, 17, 26–30). While the cause of many of these disparities is poorly understood, some investigators have suggested that racial disparity in breast cancer for example may have a biological basis, with African–American women having been found to have a more aggressive disease that occurred at a younger age (31). Similarly, in a study of Blacks and Whites receiving the same radiation treatment regimen for head and neck cancer, black patients were found to have twice the risk of distant recurrence than white patients (27% versus 13%; $P = 0.012$) (26). However, as highlighted by Ward et al. (5), risk factors associated with racial disparities in the incidence of, and survival from cancer, are multifactorial. Socioeconomic factors such as poverty, inadequate education, and lack of healthcare insurance coverage seemed to better explain racial disparities than biological differences. As stated by these investigators, poor and minority communities are often selectively targeted by the marketing strategies of tobacco companies, and may have limited access to fresh food and healthy nutrition and to recreational activities (5). Tomar et al. (17) explored racial differences in survival among Floridians with oral and pharyngeal cancer while controlling for type of cancer treatment. They found that overall there was a higher proportion of Blacks than Whites who received radiation only as treatment of their oral or pharyngeal cancer, even among those with localized disease. This finding may be interpreted in different ways: it may suggest either a racial difference with respect to availability of care, Blacks having fewer treatment options, or it may reflect a cultural difference with respect to acceptance of surgical procedures. For instance, Margolis

et al. (32) found that African–Americans were much more likely than Whites to believe that air exposure during lung cancer surgery might cause tumor spread, thus were also significantly more likely to refuse surgery as a treatment option for lung cancer.

One of the limitations of the SEER data is that it does not permit the exploration of possible biological factors that could explain racial disparities with respect to cancer outcome. However, despite the constraint inherent to registry data, it appears that the poorer relative survival we uncovered among African–Americans with oral cavity cancer might be in part explained by delayed diagnosis as suggested by the much smaller difference in survival rates between Blacks and Whites when tongue cancer was diagnosed at a localized stage. Furthermore, our analyses also revealed that not only was oral cancer diagnosed at a more advanced stage in Blacks, but they also had larger tumors at the time of diagnosis. The difference between Blacks and Whites with respect to both later stage of disease and tumor size at diagnosis was statistically significant for all sites except for the lip, which was overall diagnosed at earlier stage in both groups. Investigators in a oral and maxillofacial surgery department in Portland, OR (Legacy Hospital System) showed that overall, patients referred for oral cancer treatment from a dental office were of significantly lower stage than those referred from a medical office (33). Using the TNM system for clinical staging, these investigators found that among 51 patients referred to their clinic for treatment of squamous cell carcinoma of the oral cavity, the average clinical stage of the 32 cases referred by dental providers was 1.94 (SD 1.05), while the average clinical stage of cases referred by physicians ($n = 19$) was 3.00 (SD 0.82). A number of studies have also found significantly lower use of dental care services among African–Americans than among Whites (34–37), which would explain the higher proportion of Blacks diagnosed with spread oral cancer and with larger tumors than Whites, and thus the poorer survival.

The present analysis showing a racial disparity with respect to stage at diagnosis and relative survival among cases with oral cavity cancer, underscores the pressing need for targeted screening strategies. Many Americans who do not have a source of regular dental care may receive primary medical care, and may see either a physician or a nurse practitioner either for routine follow up or on an emergency basis. Therefore, primary care physicians and nurse practitioners could play an important role in the initial screening for oral cancer if they were trained in performing an oral soft-tissue examination. Such visual inspection of the mouth is easy to perform, and the non-dental professional can easily be trained to identify a non-healing ulcer or a persistent white and/or red plaque that may represent a pre-cancerous lesion that should be further evaluated and biopsied by either an oral medicine specialist or an oral surgeon.

Acknowledgments

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