Racial Differences in Survival of Oral and Pharyngeal Cancer Patients in North Carolina

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Abstract

Objective: *This study seeks to determine whether lower survival of black versus white oral and pharyngeal cancer patients is due to, or differs by, stage at diagnosis.* ***Methods:*** *Subjects identified through the North Carolina Central Cancer Registry included all black and white North Carolina residents diagnosed from 1987 to 1990 with malignant squamous cell carcinoma of the oral cavity or pharynx. Proportional hazards regression models were used to calculate hazard ratios for all-cause mortality during the first 18 months after diagnosis, adjusting for age, reported histologic grade, site, and several time-dependent interactions.* ***Results:*** *Within the first two months after diagnosis, the black/white hazard ratio for mortality among those with localized disease was 11.8 (95% CI=3.7, 37.5), compared to 6.4 (95% CI=2.6, 15.8) for those with advanced disease. During months 3 to 18 after diagnosis, black/white hazard ratios were 2.07 (95% CI=1.03, 4.18) among those with localized disease and 1.12 (95% CI=0.85, 1.47) for those with advanced disease.* ***Conclusions:*** *In the first 18 months after diagnosis, blacks with oral and pharyngeal cancer have higher all-cause mortality than whites diagnosed at the same stage of disease. Racial differences are greater among those with localized disease than for those with more advanced conditions.* *[J Public Health Dent 1998;58(1):36-43]*

Key Words: alcohol, blacks, epidemiology, mouth neoplasms, North Carolina, race, survival, tobacco, whites.

Over 30,000 new cases of oral and pharyngeal cancer occur each year in the United States, resulting in over 8,000 deaths annually (1). Oral and pharyngeal cancer survival rates are poor, with only 53 percent of whites and 31 percent of blacks still alive five years after diagnosis (1). Although oral and pharyngeal cancer screening is an uncomplicated, noninvasive procedure, survival rates are worse than those for cancers of the breast, prostate, uterine cervix, and colon (1) — conditions for which screening also is available.

We know of only one published study in which multivariate analyses were employed specifically to address the issue of racial differences in oral and pharyngeal cancer survival. Franco et al. (2) used proportional hazards regression to investigate 15-year survival in a cohort of Brazilian patients with cancer of the oral cavity, with separate analyses addressing "deaths due to mouth cancer" and "all deaths." Race (white/Oriental vs black/mulatto) was correlated with stage and treatment, with blacks/mulattos more likely to be diagnosed with advanced lesions and more likely to have their condition go untreated. For both all-cause and disease-specific mortality, a statistically significant racial difference in survival of lip cancer persisted when sex and age were controlled, but disappeared when stage was added to the model. For cancers of the tongue and other mouth subsites, neither crude nor adjusted hazard ratios (comparing races) were statistically significant.

Several investigations have focused on racial differences in survival of cancers other than oral and pharyngeal cancer (3-6). Of particular relevance to the present study is a report by Ragland et al. (6) in which Surveillance, Epidemiology, and End Results (SEER) data were used to assess stage-specific survival of cancers of the colon, rectum, bladder, breast, cervix, uterine corpus, and prostate. These sites were chosen because "mortality [was] considered avoidable by early detection and treatment," a statement that also applies to oral and pharyngeal cancer (7). Proportional hazards models showed that (1) no significant stage-specific racial disparities existed for colon, male rectal, and prostate cancer; (2) racial differentials persisted for male bladder, female rectal, and breast cancer; and (3) racial differences were evident at some stages but not others for female bladder, cervical, and uterine corpus cancer.

Some of the racial survival difference seen with many cancers may be attributed to a higher proportion of diagnoses of less advanced cancers among whites than blacks (8), particularly in sites for which cancer screening tests are available. This possibility is consistent with findings by Franco et al. (2), in which racial differences in lip cancer survival were explained by variations in stage at diagnosis. However, SEER data from 1973–87 show that survival is much poorer for blacks within each stage of oral and pharyngeal cancer (1), suggesting that other factors may be more important in explaining this difference. Thus, the main goals of this study were to characterize the association between race and survival for North Carolina residents diagnosed with oral and pharyngeal cancer and to determine whether this relationship varies by stage at diagnosis.

Methods

Data were obtained from the North Carolina Central Cancer Registry, which contains information on individuals diagnosed with oral and pha-

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ryngeal cancer at North Carolina hospitals since 1987. The study sample included North Carolina residents whose: (1) date of diagnosis was between January 1, 1987, and December 31, 1990; (2) race was either black or white; (3) tumor was a malignant squamous cell carcinoma of the oral or pharyngeal tissues (International Classification of Diseases for Oncology codes 140.0–149.9), excluding salivary glands (142.0–142.9) (9); (4) stage at diagnosis was either localized, regional, or distant metastases (i.e., in situ, benign, and unknown were excluded); (5) tumor histologic grade ranged from well differentiated to undifferentiated, or was unknown; and (6) date of last contact was at least one day after the date of diagnosis. For individuals with more than one eligible neoplasm, analysis was completed using only the earliest diagnosed tumor.

Hospitals had reported each case's vital status to the registry (i.e., alive or dead at last contact), but had not reported cause of death. Thus, all deaths were considered events in the present analysis. Kaplan-Meier estimates were used to evaluate the relationship between race and survival time, stratifying by selected covariates (10). Follow-up time was defined as the number of months from diagnosis to last contact. Follow-up times were censored at 18 months because (1) few deaths occurred after this point; (2) 18 months was considered to be socially meaningful; and (3) the unadjusted survival difference was substantial at 18 months, hence detection of potential confounders would be enhanced. Table 1 describes the follow-up status used in this analysis.

Race (black, white) was the primary variable of interest. Covariates included age at diagnosis, sex, stage at diagnosis (localized, regional, distant), histologic grade (unknown, well differentiated, moderately differentiated, poorly differentiated, undifferentiated), site (oral, pharyngeal), residence region (mountain, Piedmont, coastal), residence county (urban if population density ≥190 residents per square mile based on the 1990 US Census, rural otherwise), and hospital county (same as, different from residence county). Residence region, residence county, and hospital county

TABLE 1
Follow-up Status Used in Analysis by Vital Status at Last Contact

Time from Diagnosis to Last Contact	Vital Status at Last Contact	Follow-up Status Used in Analysis
≤18 months	Alive	Censored at last contact
≤18 months	Dead	Died as of last contact
>18 months	Alive or dead	Censored at 18 months

TABLE 2
RelationshipsAmong Explanatory Variables, 18-month Survival, and Race

Explanatory Variable	Description	Study Subjects (n=1,272)	Deaths by 18 Months (n=352)	18-month Kaplan-Meier Survival Estimate	Log-Rank P-value	% Black	Chi-square P-value
Race	White	961	252	.50	.02	NA	NA
	Black	311	100	.41		NA	
Age at diagnosis	14–44 years	105	16	.73	<.01	42	<.01
	45–54 years	230	53	.54		49	
	55–74 years	711	197	.48		19	
	75–108 years	226	86	.36		8	
Hospital county	Residence	532	159	.42	.01	26	.19
	Other	740	193	.53		23	
Histologic grade	Reported	940	268	.47	.21	21	<.01
	Missing	332	84	.53		33	
Residence region	Mountain/Piedmont	952	277	.47	.23	21	<.01
	Coastal	320	75	.54		34	
Residence county	Urban	663	194	.44	.03	25	.37
	Rural	609	158	.52		23	
Sex	Female	420	114	.53	.71	20	<.01
	Male	852	238	.47		27	
Site	Oral	799	198	.52	<.01	21	<.01
	Pharyngeal	473	154	.42		30	
Stage at diagnosis	Localized	404	51	.72	<.01	14	<.01
	Regional	726	232	.40		28	
	Distant	142	69	.28		37	

were included as surrogates for potential confounders that were unavailable in the database (e.g., access to care, socioeconomic status, tobacco use), while the other covariates were included based on evidence in the cancer literature indicating that they may be associated with survival.

Univariate frequency tables were generated, and the sole continuous explanatory variable, age, was assessed for normality and centered. Bivariate contingency tables were developed, and stratified analyses were conducted to assess the potential for effect modification and confounding of the association of interest. Log(–log) survival plots of each explanatory variable were created to verify the proportional hazards assumption, and time-dependent interactions were created for variables that violated this assumption (10).

After collinearity was assessed, backward selection was employed to develop proportional hazards regression models of the race-survival relationship. We decided a priori that (1) because the main study question dealt with the effect of diagnostic stage on the race-survival relationship, the three variables race, stage, and the race by stage interaction would be forced into each model; (2) main effect terms would be included in the model if their removal elicited at least a 10 percent change in the black/white hazard ratio or if their *P*-value was less than .05 (based on the Wald chi-square statistic), controlling for other variables in the model; and (3) interaction terms would be kept if their *P*-value was less than .20, controlling for other variables in the model. SAS Version 6.08 for Windows was used for all statistical analyses. Stratified analyses were conducted using PROC FREQ and PROC LIFETEST; PROC PHREG was used for proportional hazards modeling.

Results

A total of 1,272 observations were included in the analysis, of which 311 (24%) represented blacks. During preliminary analyses it was noted that 332 individuals (26%) were missing a value for histologic grade, so this variable was reclassified as a binary variable (reported, missing). Likewise, due to the limited number of blacks living in the mountain region, mountain and Piedmont residents were combined to create a dichotomous variable for residence region.

FIGURE 1
Survival Curves for Oral and Pharyngeal Cancer, by Race

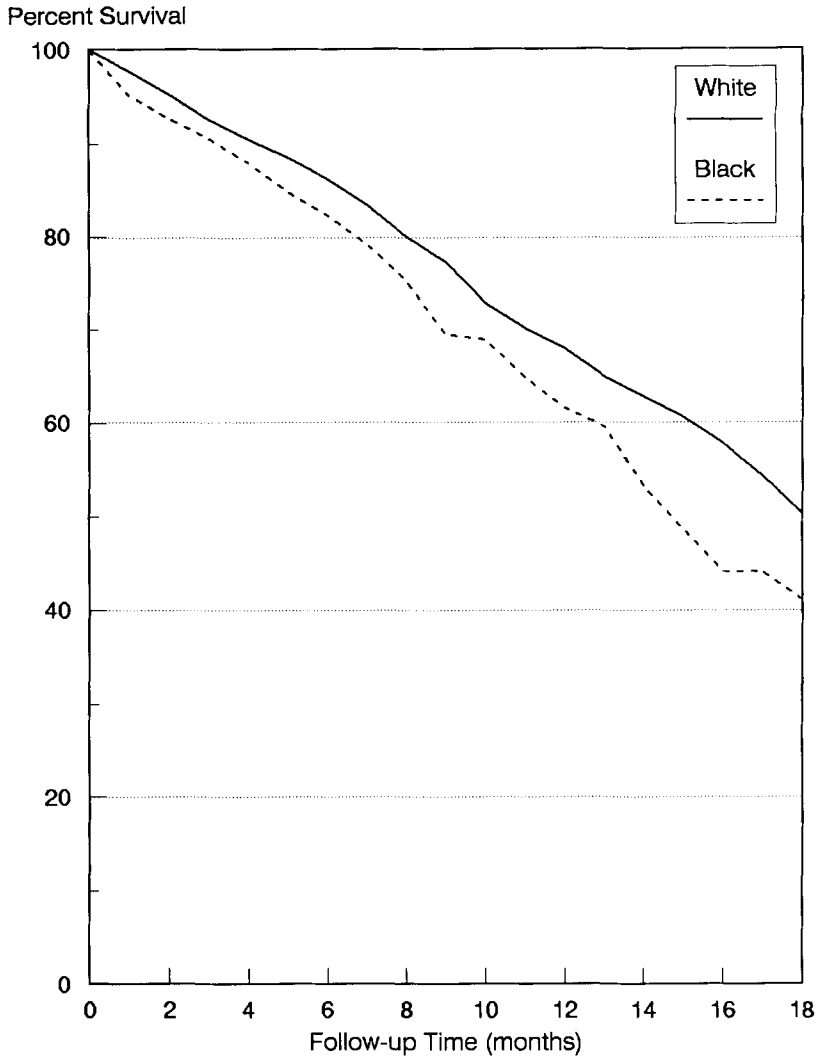


Table 2 shows the relationship between (1) the explanatory variables and 18-month survival, and (2) the covariates and race. Survival was significantly associated with race, age (grouped for ease of interpretation), hospital county, residence county, site, and stage ($P<.05$). Race was significantly associated with age, grade, residence region, sex, site, and stage. Unadjusted survival curves by race are presented in Figure 1. The log-rank *P*-value of .021 (X^2, 1 df) implies a statistically significant difference between the two curves over the 18-month period.

Results from the stratified analyses are reported in Table 3. Eighteen-month Kaplan-Meier survival estimates for blacks were lower than those for whites in almost every stratum. Discrepancies were most noticeable by age (blacks fared more poorly than whites in all but the oldest group), by site (racial difference greater for oral than for pharyngeal cancer), and by stage (racial difference greater for those diagnosed with localized disease than for those diagnosed with regional or distant disease). Figure 2 shows survival curves for blacks and whites stratified by stage at diagnosis. The spread between the two curves is noticeably greater for those diagnosed with localized disease ($P=.068$) than among those diagnosed with either regional disease ($P=.915$) or distant me-

TABLE 3
Relationship Between Covariates and 18-month Survival by Race

Covariate	Description	Whites			Blacks		
		Whites (*n*=961)	Deaths by 18 Months (*n*=252)	18-month Kaplan-Meier Survival Estimate	Blacks (*n*=311)	Deaths by 18 Months (*n*=100)	18-month Kaplan-Meier Survival Estimate
Age at diagnosis	14–44 years	61	7	.81	44	9	.60
	45–54 years	118	25	.62	112	28	.45
	55–74 years	575	141	.52	136	56	.32
	75–108 years	207	79	.35	19	7	.60
Hospital county	Residence	392	112	.44	140	47	.35
	Other	569	140	.54	171	53	.46
Histologic grade	Reported	739	205	.49	201	63	.38
	Missing	222	47	.57	110	37	.46
Residence region	Mountain/Piedmont	750	208	.49	202	69	.38
	Coastal	211	44	.59	109	31	.47
Residence county	Urban	494	137	.47	169	57	.35
	Rural	467	115	.54	142	43	.49
Sex	Female	338	90	.54	82	24	.49
	Male	623	162	.49	229	76	.39
Site	Oral	631	147	.55	168	51	.40
	Pharyngeal	330	105	.42	143	49	.41
Stage at diagnosis	Localized	347	41	.73	57	10	.61
	Regional	525	166	.40	201	66	.39
	Distant	89	45	.26	53	24	.30

tastases (P=.925).

Main effect variables selected for inclusion in the full proportional hazards regression model were based on the strength of associations between the covariates, race, and survival among the entire sample (Table 2), while interaction terms were selected based on variations in racial survival differences within each covariate (Table 3). The full model included the forced terms (race, stage, and race by stage), covariates (site, grade, age, hospital county, and residence region), and interactions for race by age and race by site.

Follow-up time was dichotomized at <2 versus ≥2 months because in log(–log) survival plots, four variables (race, age, grade, and site) appeared to violate the proportional hazards assumption at that point (results not shown). Time-dependent interactions were created for each of these variables and also were included in the full model.

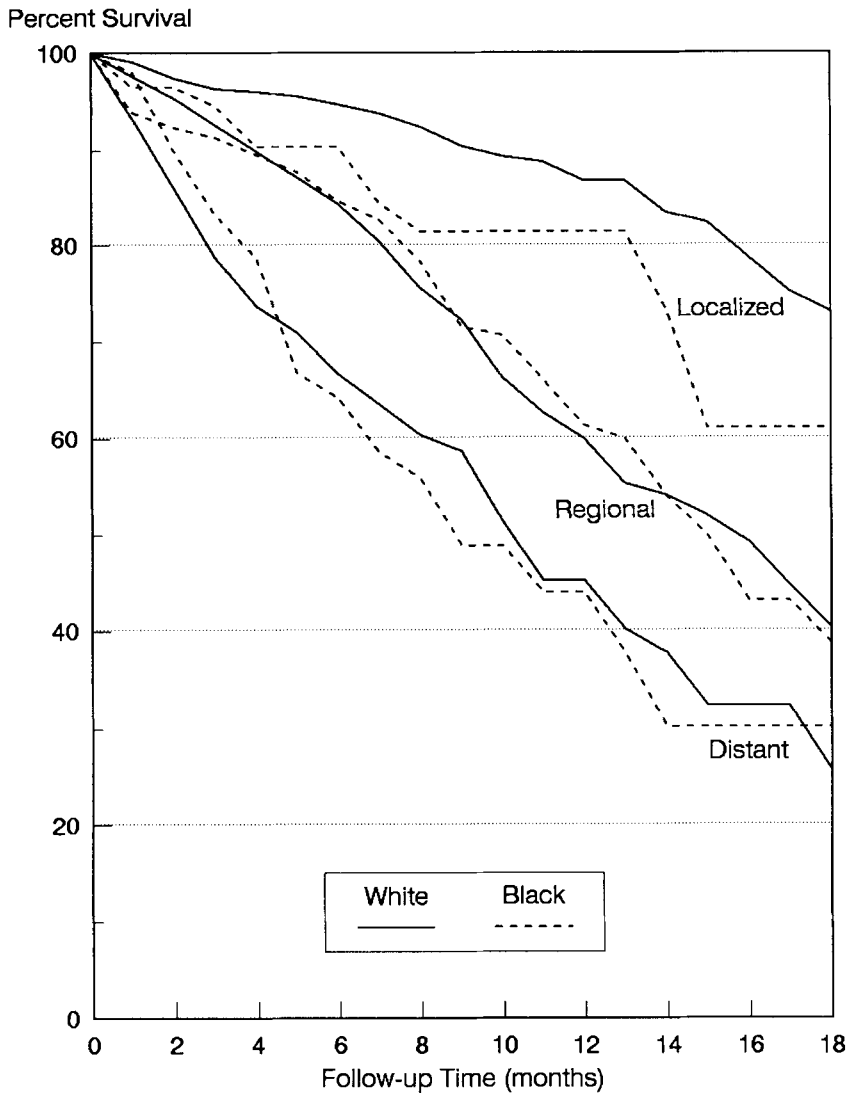
Of the 352 individuals (27.7%) who died within 18 months of diagnosis, almost one-fifth died during the first two months (Table 4). Of these, relatively more blacks than whites died (7.1% vs 4.5%). Among those with localized disease, 17.5 percent of the blacks died within 18 months of diagnosis, compared to only 11.8 percent of the whites. However, among those with regional disease or distant metastases, similar percentages of blacks and whites died within 18 months.

Prior to generation of regression models, three observations were evaluated as potential outliers based on age at diagnosis: two cases aged 14 and 15 years (because individuals this young rarely develop oral and pharyngeal cancer), and one case aged 108 years (because the next-oldest case was diagnosed at age 98). However, since regression models including and excluding these observations were not appreciably different, results include data from all 1,272 cases.

Table 5 shows parameter estimates and standard errors for variables in the final model. P-values are reported only for variables not involved in a significant interaction term with race; P-values also are not reported for time-dependent interaction terms because these terms are included only to satisfy proportional hazards assumptions. Death rates increased with age, and hazards for those with no grade reported were more than three times those for individuals with grade reported in the registry. Hazards for pharyngeal cancer patients were over eight times that of oral cancer patients, controlling for other variables in the model.

Because racial differences for those with regional and distant disease were small relative to those for patients diagnosed with localized disease (Figure 2), the race by stage interaction term compared those with localized disease against those in the two other groups combined. Its statistical significance implies that distinct black/white hazard ratios exist for each time-by-stage combination; these are shown in Table 6. During months 3–18 after diagnosis, blacks tended to have about twice the hazard of whites, but only among those with localized disease. No appreciable difference was evident for those diagnosed at more

FIGURE 2
Survival Curves for Oral and Pharyngeal Cancer, by Race and Stage at Diagnosis



advanced stages. However, during the first two months after diagnosis, blacks with localized disease had a death rate 12 times that of whites in comparable stages, while blacks with regional or distant disease had hazards about six times that of whites in comparable stages.

Finally, although oral and pharyngeal cancer data have been collected by the registry since 1987, registry officials estimate that complete case ascertainment was not achieved until 1990 or later. For that reason, we explored the possibility of bias due to underascertainment of cases from 1987–89. Table 7 shows that the number of hospitals reporting oral and pharyngeal cancer cases to the registry climbed steadily from 1987 to 1990, as did the number of cases reported. Neither age nor stage at diagnosis varied systematically; however, blacks could have been underascertained in 1987. Proportional hazards models using only 1990 data confirmed the results from the total sample, including the stage-dependent nature of the race-survival relationship (results not shown).

Discussion

The development of oral and pharyngeal cancer is linked strongly to tobacco and alcohol use, with a dose-response relationship evident for each substance (11,12). The use of both appears to increase oral and pharyngeal cancer risk in a multiplicative fashion (11), and the two products are estimated to account for 75 percent of all oral and pharyngeal cancer cases na-

TABLE 4
Number and Percent Died, All Causes, by Time after Diagnosis

		0–2 Months after Diagnosis		3–18 Months after Diagnosis		Total	
	n	Number	%	Number	%	Number	%
Whites	961	43	4.5	209	21.7	252	26.2
Blacks	311	22	7.1	78	25.1	100	32.1
Localized	404	10	2.5	41	10.1	51	12.6
Regional	726	38	5.2	194	26.7	232	32.0
Distant	142	17	12.0	52	36.6	69	48.6
Localized whites	347	8	2.3	33	9.5	41	11.8
Localized blacks	57	2	3.5	8	14.0	10	17.5
Regional whites	525	23	4.4	143	27.2	166	31.6
Regional blacks	201	15	7.5	51	25.4	66	32.8
Distant whites	89	12	13.5	33	37.1	45	50.6
Distant blacks	53	5	9.4	19	36.0	24	45.3
Total	1,272	65	5.1	287	22.6	352	27.7

TABLE 5
Final Proportional Hazards Regression Model

	Variable	Parameter Estimate	Standard Error	*P*-value	Hazard Ratio (95% CI)
Main effect terms	Race (white=0, black=1)	2.468	.590		
	Age at diagnosis (continuous, centered at 60 years)	.118	.018	<.001	1.13 (1.09, 1.17)
	Histologic grade (reported=0, missing=1)	1.171	.371	.002	3.23 (1.56, 6.67)
	Site (oral=0, pharyngeal=1)	2.097	.462	<.001	8.15 (3.30, 20.12)
	Regional stage at diagnosis (localized/distant=0, regional=1)	1.138	.176		
	Distant stage at diagnosis (localized/ regional=0,distant=1)	1.759	.204		
Interactions involving race	Race * (regional or distant stage)	–.618	.377		
Interactions involving time	Race * time ≥ 2 months	–1.739	.482		
	Age at diagnosis * time ≥ 2 months	–.097	.018		
	Histologic grade * time ≥ 2 months	–1.430	.392		
	Site * time ≥2 months	–2.039	.470		

TABLE 6
Black/White Hazard Ratios and 95% CI, by Time after Diagnosis

Stage at Diagnosis	0–2 Months after Diagnosis	3–18 Months after Diagnosis
Localized	11.8 (3.7, 37.5)	2.07 (1.03, 4.18)
Regional or distant	6.4 (2.6, 15.8)	1.12 (0.85, 1.47)

tionwide (11). Thus, many members of the present cohort likely were users of tobacco and/or alcohol. Although the present outcome was survival rather than incidence, racial variations in the use of tobacco and alcohol could account for some of the observed disparity in survival if survival parallels oral and pharyngeal cancer incidence. The authors of one paper concluded that "in the absence of alcohol and tobacco, the rates of this cancer according to race and sex would be nearly equal" (13). If these factors were to explain our findings of racial differences in survival, use of tobacco and alcohol would have to have been much higher in blacks than in whites. The absence of data on such lifestyle differences in North Carolina precludes an assessment of their role in the race-survival relationship.

Race, as used here, should be considered a surrogate for unavailable variables that potentially may be correlated with survival, including family income, education level, and social and cultural factors. Oral and pharyngeal cancer treatment generally includes various combinations of surgery, radiation, and chemotherapy (14); however, the registry did not include treatment data. In addition, the presence of histologic grade in the model does not indicate that more poorly differentiated tumors were associated with decreased survival, as in other studies evaluating this variable (15); it merely reflects the presence or absence of a recorded value for grade in the registry, which may be a surrogate for socioeconomic status. In sum, as with most retrospective studies, had several potentially important variables been available or more complete, this investigation could have resulted in different findings.

TABLE 7
Characteristics of Study Sample by Year of Diagnosis

Year of Diagnosis	# Hospitals Reporting ≥1 Case	No. Cases Reported	% Diagnosed at Age ≥65	% Diagnosis with Disease			% Black	% with Oral Cancer
				Localized	Regional	Distant		
1987	13	195	44	36	53	11	19	58
1988	16	265	47	35	55	11	24	63
1989	20	368	45	26	62	12	27	60
1990	45	444	45	33	56	11	25	67

Cancer survival often is described using five-year survival rates; the present data, however, did not cover five years. In fact, only 79 individuals (6.2%) were followed longer than 18 months, mainly due to the registry's lack of resources to conduct active follow-up (i.e., the registry did not contact cases periodically after hospital discharge via telephone or mail). Hospitals reported the vital status of each case based on medical record abstraction completed quarterly, semiannually, or annually, depending upon hospital size. Regardless of the frequency and methods of record abstraction, we have no reason to believe that the follow-up protocol was different by race.

In 1987 reporting hospitals were primarily larger institutions that already had their own registries, so the additional burden of reporting cases to the state registry was minimal. By 1990 participation grew to include 130 of the state's 132 hospitals (Kryn Krautheim, personal communication). Although the state registry's coverage became more complete with time, the methodologies used to collect the relevant information did not change appreciably and, again, would not be expected to differ by race.

The outcome used was death due to all causes because the cause of death was not present in the data base and resources were not available to obtain it at the time of this analysis. However, in North Carolina, the age-adjusted mortality for blacks exceeds that for whites, even after controlling for educational attainment (16); thus, some of the observed racial survival difference may be explained by competing causes of death, despite the fact that blacks tended to be younger than whites (Table 2). Death from competing causes is of special interest, considering the frequency with which second primary tumors develop among those diagnosed with oral and pharyngeal cancer (17,18).

Only after completion of the present analysis were the authors able to obtain cause of death. Preliminary evaluation of these data (not shown) indicates that over all stages, oral and pharyngeal cancer was the underlying cause of death for 52.3 percent of whites and 53.4 percent of blacks dying within 18 months of diagnosis, indicating that competing causes were responsible for similar proportions of deaths among the two races. However, among those diagnosed with localized oral and pharyngeal cancer, a higher proportion of blacks than whites died from the disease (66.7% vs 36.1%, respectively), while among those with regional or distant oral and pharyngeal cancer, the proportion of blacks and whites dying from oral and pharyngeal cancer was roughly equivalent (51.9% vs 55.5%, respectively).

These findings suggest that the use of oral and pharyngeal cancer-specific mortality would have produced racial disparities that were similar to (or potentially even stronger than) those found using all-cause mortality, and thus would not have altered our conclusions. We also note that Franco et al. (2) found essentially no difference in hazard ratio estimates generated using all-cause mortality and disease-specific mortality as endpoints in their study of racial differences in survival of oral cavity cancer.

Proposed explanations for racial differences in cancer survival have been summarized elsewhere (19), and include variations in (1) preventive behavior, (2) staging procedures (i.e., thoroughness of medical evaluation), (3) aggressiveness of tumor types, (4) host vulnerability, (5) aggressiveness of prescribed therapy, (6) compliance with recommended treatment, and (7) social support and coping mechanisms. The present study design precluded a thorough exploration of these issues. However, 36 percent of blacks in this study were missing a value for histologic grade compared to only 23 percent for whites, and the observed racial difference in this variable could reflect racial variations in the quality of medical care received. If so, blacks could also have been understaged relative to whites (i.e., blacks may have undergone fewer diagnostic procedures and thus may have had tumors classified as localized that really were more advanced). Under this scenario, black/white hazard ratios among those with localized disease might be less than we observed, while hazard ratios among those with regional or distant involvement might be greater.

The inclusion of the race by stage interaction in the present analysis permitted an evaluation of black/white disparities within stage, which would minimize the influence of differences in disease status at diagnosis. Racial differences were substantial within two months after diagnosis, with blacks dying six to 12 times as frequently as whites, controlling for other variables in the model (Table 6). From three to 18 months after diagnosis, blacks diagnosed with localized disease were about twice as likely to die than whites; among those with more advanced disease, however, no difference was observed.

The hazard ratios corresponding to zero to two months after diagnosis were unexpectedly high compared with those corresponding to three to 18 months after diagnosis. No suitable explanation is apparent for this finding, which is based on a small number of cases. Differential comorbidity was considered as a possible cause, but was not borne out in a preliminary analysis of the cause of death data. As such, this result remains interesting, but should be treated with caution because of the small number of cases.

Overall, this analysis suggests that variations in diagnostic stage do not explain the difference in survival between blacks and whites diagnosed with oral and pharyngeal cancer. This finding is consistent with SEER data (1), for which the reported five-year relative survival percentages for whites (77%, 42%, and 18% for localized, regional, and distant oral and pharyngeal cancer, respectively) exceed the corresponding percentages for blacks (57%, 30%, and 14%). In addition, both these SEER figures and the present results suggest that racial survival differences are greater among those diagnosed with oral and pharyngeal cancer in the early stages, and decline as the stage at diagnosis becomes more advanced. Greater differences among those diagnosed with localized disease may reflect racial variations in treatment, social support, or other postdiagnosis factors that this study was unable to address.

Since oral and pharyngeal cancer is most curable when detected early, the importance of screening, which is intended to diagnose disease at an early stage, cannot be overemphasized. Public health dentists and other health care professionals who care for patients at high risk of developing oral and pharyngeal cancer (i.e., tobacco and alcohol users, older individuals) should be acutely aware of the impact that early diagnosis can have on those

diagnosed with oral and pharyngeal cancer. Disheartening are findings that only about 14 percent of US adults over the age of 18 report ever having had an oral cancer examination (7), and that only 83 percent of dentists and 18 percent of physicians in a Maryland convenience sample report performing yearly oral cancer examinations for at least half their patients (20).

In conclusion, the most important findings from this study of North Carolina patients diagnosed with oral and pharyngeal cancer from 1987–90 were (1) stage at diagnosis did not account for the black/white difference in 18-month survival, and (2) racial survival differences were greater among those diagnosed with less advanced disease. Evidence from the breast cancer literature (21) suggests that some of the racial difference in survival may be due to blacks having relatively more advanced disease than whites within each stage at diagnosis (e.g., among those with localized oral and pharyngeal cancer, blacks may have larger tumors than whites). Future investigations should augment the present study by controlling for disease extent using the TNM diagnostic system (22), incorporating longer periods of follow-up, and using multiple outcomes (e.g., all-cause mortality, oral and pharyngeal cancer as the underlying cause of death, oral and pharyngeal cancer as a contributing cause of death). In addition, they should attempt to ascertain behavioral, socioeconomic, and treatment-related determinants of the observed racial differences so that interventions can be implemented that would help improve the survival of oral and pharyngeal cancer patients. Prospective study designs should prove useful to this effort, as would the exploration of state and national cancer data bases, like SEER, which include treatment information.

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