# Oral Cancer Knowledge and Examination Experiences Among North Carolina Adults

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Abstract

***Objective:*** *This study assesses knowledge of oral cancer risk factors, clinical signs, and oral cancer examination experience among North Carolina adults.* ***Methods:*** *A statewide random digit dial, computer-assisted telephone interview was conducted in 2002. Data from 1,096 respondents, with a response rate of 62 percent, were poststratified to 2000 census data by sex, race, and age group to produce population-based estimates. Knowledge of one sign of oral cancer, four or more risk factors for oral cancer, and having ever had an oral cancer examination were compared in logistic regression models using normalized weights.* ***Results:*** *Fourteen (95% confidence interval [CI] ±2) percent of adults had never heard of oral or mouth cancer. Risk factor knowledge was high for 56 percent (95% CI±3) and associated in a logistic regression model with younger age, feeling personal factors cause cancer, and nonuse of snuff. One sign of oral cancer (sore/lesion, red or white patch in mouth, and bleeding in the mouth) was correctly identified by 53 percent (95% CI±3) with significantly more correct responses from younger people, nonsmokers, and some college education. Only 29 percent (95% CI±3) reported ever having had an oral cancer examination when this procedure was described. Most respondents reported exams performed by dentists. In a weighted logistic regression model, older age, being dentate, nonsmokers, alcohol users, and those with some college education were significantly more likely to report having ever had an oral cancer examination.* ***Conclusions:*** *Although there is moderate knowledge of signs and risk factors for oral cancer among North Carolina adults, knowledge deficits remain. Oral cancer examinations need to be increased, particularly among tobacco smokers. [J Public Health Dent 2004;64(3):173-80]*

*Key Words: oral cancer, mouth neoplasms, knowledge, prevention, early detection, oral cancer examinations.*

Cancers of the oral cavity and pharynx are a public health concern—with 28,260 new cases and 7,230 deaths expected in the United States in 2004 (1). Unfortunately, most oral cancers are diagnosed in advanced stages, requiring aggressive treatment and associated morbidity, and resulting in higher mortality rates than when diagnosed early. (2) Consequently, the overall five-year relative survival rate for persons of all races in the US diagnosed with oral cavity and pharynx cancer is 57 percent, varying dramatically by stage at diagnosis from 82 percent for localized disease, 48 percent for regional disease, and only 26 percent when distant disease is present at diagnosis (3).

North Carolina has the 15th highest mortality rate for cancers of the oral cavity and pharynx among the 50 states and the District of Columbia (3). With an annual age-adjusted mortality rate (death years 1996–2000) for oral cavity and pharyngeal cancer of 3.0 (95% confidence interval [CI]=2.8, 3.2) deaths per 100,000, North Carolina fails to meet the Healthy People 2010 Objective 2.7 (3,4). North Carolina African Americans had higher mortality rates over this same time period, with 4.4 (95% CI=3.9, 4.9) deaths per 100,000 (3). Previous studies have shown that blacks in North Carolina are twice as likely as whites to be diagnosed with oral and pharyngeal cancer at advanced stages (5) and they have higher all-cause mortality by 18 months after diagnosis than whites diagnosed at the same stage of disease, with racial differences in survival being greater among those with localized disease than for those with more advanced cancers (6). Taken together, these epidemiologic findings suggest that North Carolina adults as a group, and particularly black residents, may fare poorly when it comes to early detection and receiving effective treatment for oral and pharyngeal cancers.

A combination of personal knowledge of oral cancer signs and risk factors, personal awareness of oral health status, and professional oral cancer examinations may influence the early detection, and morbidity and mortality of oral cancers. The extent to which knowledge and examination experience influence the high oral cancer mortality rate and disproportionate burden among blacks in North Carolina is unknown. The primary purposes of this study were: (1) to identify levels of public awareness in North Carolina about oral cancer risks and signs of oral cancer as well as to document North Carolina adults' experience with oral cancer exams; and (2) to assess in multivariable models the association of various background variables (e.g., sociodemographic, behavioral, knowledge, personality, and

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dentate status exposure) on three outcomes—knowledge of signs of oral cancer, oral cancer risk factor knowledge, and having ever had an oral cancer examination.

## Methods

The Survey Research Unit of the University of North Carolina (UNC) School of Public Health conducted interviews with adults in the state of North Carolina using a random digit dialing, simple random sampling approach between January and June 2002. A sample of telephone numbers using a strict single-stage (Epsem) design was purchased from GENESYS Sampling Systems (Fort Washington, PA). One adult per eligible household was randomly selected to complete the interview. Blaise, a computer assisted telephone interview (CATI) software package developed by Statistics Netherlands (7), was used to administer the questionnaire, as well as manage call scheduling, which included a minimum of 12 callbacks representing various times of the week (e.g., weekend, weekday, and weekend periods).

A total of 4,181 telephone numbers were called. Completed interviews were obtained from 1,096 adults. Of the remaining numbers, 1,828 numbers were ineligible (e.g., number no longer in service, business/fax number); 597 were of unknown eligibility because maximum call attempts resulted in no answer; and 660 were eligible but did not complete an interview for various reasons (e.g., refusals, unavailable for length of study, or had medical constraints). A response rate of 62 percent was established, based on the American Association for Public Opinion Research Standard Definitions (8), by taking the number of completes and dividing by the number of eligible cases (1,096/1,096+660).

To improve generalizability, sample weights were used to adjust the responses given by individuals in this sample to the target population of adults in North Carolina. In addition to allowing state estimates to be generated, this was done to account for the statistical probability of selection for each member of the sample and to correct for the level of demographic imbalance from imperfect response rates and phone coverage rates that vary within the population. Poststratification adjustments were computed on the basis of sex (male/female), race (black/white/other), and age group (18–39 years/40–64 years/65+ years old) using Census 2000 data (9).

The original survey instrument, adapted from 1990 and 1992 National Health Interview Surveys (NHIS) and used in Maryland (10), was modified in some content areas and pretested on a random sample of 42 adults in North Carolina by CATI. Objectives of the pretest were to identify potential problems in comprehension and interpretation of the survey questions, to assess length of the interview, and to determine any possible areas for improvement in the telephone introduction. The final survey containing 36 questions took on average 12 minutes to complete. Topic areas included: (1) knowledge of risk factors for and signs and symptoms of oral cancer; (2) whether respondents had ever had an oral cancer examination and, if so, when the exam had occurred and, if not, why not; (3) respondent's use of

**TABLE 1**
**Bivariate Analysis of Variables by Knowledge of One Sign of Oral Cancer**

| Variable* | *n* | % Persons Who Knew 1 Sign | *P*-value |
|---|---|---|---|
| **Age (years)** | | | |
| 18–39 | 478 | 46.7 | |
| 40–64 | 447 | 60.3 | |
| ≥65 | 167 | 50.5 | **<.001** |
| Sex | | | |
| Male | 529 | 50.5 | |
| Female | 566 | 55.0 | .132 |
| **Race** | | | |
| White | 814 | 55.3 | |
| Black | 219 | 46.1 | |
| Other minorities | 38 | 58.2 | **.046** |
| **Education (years)** | | | |
| ≤12 | 500 | 41.9 | |
| >12 | 595 | 62.1 | **<.001** |
| Dentition status | | | |
| Edentulous | 101 | 46.2 | |
| Dentate | 993 | 53.5 | .164 |
| **Risk factor knowledge score** | | | |
| 0–1 | 29 | 19.0 | |
| 2–3 | 453 | 49.6 | |
| 4–5 | 612 | 56.9 | **<.001** |
| Main cause of cancer | | | |
| Personal behaviors | 618 | 53.8 | |
| Environmental factors | 416 | 54.9 | .716 |
| Concern about cancer | | | |
| Very concerned | 252 | 51.3 | |
| Somewhat concerned | 631 | 55.7 | |
| Not concerned | 202 | 47.2 | .088 |
| **Smoke cigarettes** | | | |
| Every day/some days | 253 | 43.2 | |
| Not at all/never | 838 | 55.7 | **<.001** |
| Use of smokeless tobacco/chew/snuff | | | |
| Every day/some days | 58 | 49.6 | |
| Not at all/never | 1,035 | 53.1 | .606 |
| Drink alcohol | | | |
| Every day/some days | 498 | 54.5 | |
| Not at all/never | 594 | 51.5 | .325 |

*Significant variables in boldface.

**TABLE 2**
**Multivariable Logistic Regression Model for Knowledge of One Sign of Oral Cancer (*n*=974)**

| Variable | Odds Ratio | 95% Confidence Interval |
|---|---|---|
| Age (years) | | |
| 18–39 (reference group) | 1.74 | 1.34, 2.25 |
| 40–64 | | |
| Cigarette smoking | | |
| Not at all/never (ref) | 0.69 | 0.51, 0.93 |
| Some days/every day | | |
| Education (years) | | |
| >12 (ref) | 0.47 | 0.36, 0.61 |
| ≤12 | | |

tobacco and alcohol products; (4) interval since medical and dental visits; (5) Whether they had been asked about their use of tobacco and alcohol by their health care providers; and (6) demographic information. This voluntary confidential survey was approved by the UNC School of Dentistry Committee on Research Involving Human Studies.

Data analyses were performed using normalized weighted data in the SAS Statistical Software Package (Cary, NC). Items of interest for bivariate analysis with chi-square and logistic regression analysis were: (1) knowing one early sign of oral cancer (white patches, red patches, a sore/lesion, or bleeding in the mouth); (2) knowing risk factors for oral cancer (stating tobacco use in any form, regular alcohol drinking, and excessive exposure to sunlight are related to the risk of mouth or lip cancer and responding that eating hot spicy foods and frequently biting the cheek or lip are not related to the chance of getting mouth or lip cancer); and (3) having had an oral cancer examination. Descriptive analyses also revealed what proportion of exams were done by medical and dental providers, and the reason for and years since the exam. Proc Survey Means was used to generate population-based estimates and error bounds for outcome and exposure variables used in modeling.

A composite "risk factor knowledge" score was created by summing the number of correct responses to the five items. This was reduced to three categories (0–1 vs 2–3 vs 4–5) for bivariate and logistic regression analysis; however, only two categories were used as outcomes in bivariate and logistic modeling (four or more vs fewer than four correct). The statistical significance of the coefficients in the logistic regression models was tested using the Wald statistic at the .05 level to determine which variables to include in the regression model. Odds ratios and 95 percent confidence intervals were calculated from the regression coefficients and standard errors. A *P*-value of <.05 was used as the criterion for retaining variables in the final logistic regression models. Analyses were exploratory with no interactions hypothesized a priori.

## Results

Distribution of respondents by sex, race, and age groups as compared to the target population of North Carolina in 2000 favored females, nonblack minorities, and older adults. Specific comparisons between respondents and the North Carolina population, in percent, are: (1) male sex: 40 vs 48; (2) black race: 17 vs 20, and nonblack minorities: 10 vs 6; (3) age 40–64 years: 47 vs 41, and age 65 years and older: 16 vs 15. No formal education beyond high school was reported by 46 percent of respondents. These imbalances were corrected in the weighting process to bring the sample back in line with the demographic profile of the state. A personal history of cancer was reported by 10 percent, none involving oral sites, while immediate family members of 36 percent had been diagnosed with cancer, of which 3 percent had oral cancer. All the estimates that follow are population-based and 95 percent confidence bounds are given parenthetically.

**Knowledge.** Fourteen percent (±2) of adults in the state of North Carolina had never heard of oral or mouth cancer. In response to the open-ended question "What is one early sign of oral or mouth cancer?," 53 percent (±4) were able to accurately state a white patch, red patch, sore/lesion, or bleeding in the mouth; however, 25 percent (±3) stated they did not know of any early signs.

In determining adult awareness of the risk factors for oral cancer, a question was asked: "I am going to read a list of things that may or may not be related to oral cancer or cancer of the mouth, tongue, throat, or lip. For each of these, please tell me if you think that it is related or not related to a person's chance of getting cancer." Five primary risk factor responses, used in the formation of the knowledge score, included three true risk factors: (1) tobacco use in any form (94% ±2 correct as related), (2) regular alcohol drinking (49% ±3 correct as related), and (3) excessive exposure to sunlight (63% ±3 correct as related), and two nonrisk factors: (4) eating hot and spicy foods (82% ±3 correct as not related), and (5) frequently biting the lip or cheek (65% ±3 correct as not related). The composite risk factor knowledge score included: 3 percent (±1) scoring low at 0–1 correct;, 41 percent (±3) scoring in the middle at 2–3 correct, and 56 percent (±3) scoring high with 4–5 correct.

The bivariate associations of variables potentially associated with knowledge of one or more signs are shown in Table 1. Significant associations with knowledge of one or more sign of oral cancer were found for age 40–64 years, whites/others, those with more than a high school education, those with higher oral cancer risk factor knowledge scores, and those who do not smoke cigarettes. The logistic regression model (Table 2) maintained the significance of all factors identified in the bivariate analysis except race. Because of high correlation of knowledge of risk factors and signs of oral cancer, each was excluded from modeling for the other.

Bivariate results for knowledge of four or more risk factors are shown in Table 3. Significant associations with high risk factor knowledge were found for younger age, having more than a high school education, being dentate, feeling personal behaviors over which one has control cause most

cancers, being concerned about cancer, not using smokeless tobacco, and knowing one or more sign of oral cancer. In a logistic regression model (Table 4) of factors found to be significant in bivariate analysis, only three factors included in the model remained significant, including younger age, not being a smokeless tobacco user, and feeling personal behaviors cause most cancers.

**Experience.** Reported medical and dental service utilization was high; 85 percent (±2) had been to a dentist and 91 percent (±2) had been to a physician in the last three years. Most adults reported having at some time been asked by their physician if they used tobacco (79% ±3) and alcohol (76% ±3), while fewer had been asked about tobacco and alcohol use by their dentist (54% ±3 and 36% ±3, respectively).

When asked the question: "Have you ever had an exam for oral or mouth cancer in which the doctor or dentist pulled on your tongue, sometimes with gauze wrapped around it, and felt under the tongue and inside the mouth?," only 29 percent (±3) responded yes. The main reasons for having had the oral cancer examination were as part of a routine dental exam (66% ±6), to evaluate a specific new problem (11% ±4), and as part of a routine physical exam (10% ±4). At their last oral cancer examination, a majority of adults were examined by dentists (61% ±6); however, other professionals contributed to these examinations, including physicians (25% ±6), dental hygienists (8% ±3), nurse practitioners (3% ±2), and other/unknown provider type (4% ±3). The most recent oral cancer examination was performed within the last year for 67 percent (±6), and between one and three years ago by an additional 22 percent (±5). The most common responses for why most adults had not had a recent or ever had an oral cancer examination were given as "no reason/never thought of it/didn't know I should" (43% ±4), "not needed/didn't have any problems" (26% ±3), and "dentist or physician did not recommend it" (16% ±3). Of note, 23 percent (±3) of those aged 40 years and older reported having had an oral cancer examination within the last year.

Results of the bivariate analysis of factors potentially associated with having ever had an oral cancer examination are shown in Table 5. Significant associations were found for older age, having more than a high school education, being dentate, being a nonsmoker, drinking alcohol, and knowing one or more sign of oral cancer. In a logistic regression model (Table 6), all variables with significant associations in bivariate analysis remained significant except knowledge of oral cancer signs. Importantly, adults without any teeth were almost four times less likely than adults with teeth to recall having received an oral cancer examination. Smokers were 2.3 times less likely and people who were not educated beyond high school were 1.7 times less likely to recall having received an oral cancer examination than nonsmokers and those with some college education, respectively.

**TABLE 3**
**Bivariate Analysis of Variables by Knowledge of Risk Factors for Oral Cancer**

| Variable* | *n* | % Persons Who Had 4+ Score | *P*-value |
|---|---|---|---|
| **Age (years)** | | | |
| 18–39 | 480 | 65.5 | |
| 40–64 | 447 | 54.0 | |
| ≥65 | 167 | 32.6 | **<.001** |
| Sex | | | |
| Male | 529 | 55.4 | |
| Female | 567 | 56.3 | .780 |
| Race | | | |
| White | 815 | 55.3 | |
| Black | 219 | 57.2 | |
| Other minorities | 38 | 64.7 | .483 |
| **Education (years)** | | | |
| ≤12 | 501 | 52.6 | |
| >12 | 595 | 58.6 | **.049** |
| **Dentition status** | | | |
| Edentulous | 101 | 41.1 | |
| Dentate | 994 | 57.3 | **.002** |
| **Main cause of cancer** | | | |
| Personal behavior | 619 | 60.6 | |
| Environmental factors | 416 | 50.8 | **.002** |
| **Concern about cancer** | | | |
| Very concerned | 252 | 57.8 | |
| Somewhat concerned | 631 | 59.2 | |
| Not concerned | 202 | 44.9 | **.001** |
| Smoke cigarettes | | | |
| Every day/some days | 254 | 57.4 | |
| Not at all/never | 838 | 55.4 | .563 |
| **Use of smokeless tobacco/chew/snuff** | | | |
| Every day/some days | 58 | 36.3 | |
| Not at all/never | 1,036 | 57.0 | **.002** |
| Drink alcohol | | | |
| Every day/some days | 499 | 59.0 | |
| Not at all/never | 594 | 53.4 | .064 |
| **Oral cancer sign knowledge** | | | |
| Know 1+ sign | 579 | 60.2 | |
| Know no signs | 516 | 51.3 | **.003** |

*Significant variables in boldface.

## Discussion

The validity and reliability of population-based survey research can be influenced by survey design, question

**TABLE 4**
**Multivariable Logistic Regression Model for High Knowledge Score About Risk Factors for Oral Cancer (4 or more correct answers) ($n$=974)**

| Variable | Odds Ratio | 95% Confidence Interval |
|---|---|---|
| Age (years) | | |
| 18–39 (reference group) | 0.65 | 0.49, 0.85 |
| 40–64 | | |
| Age (years) | | |
| 18–39 (ref) | 0.41 | 0.27, 0.62 |
| ≥65 | | |
| Main cause of cancer | | |
| Environmental factors (ref) | 1.49 | 1.14, 1.93 |
| Personal factors | | |
| Use of smokeless tobacco/chew/snuff | | |
| Not at all/never (ref) | 0.39 | 0.21,0.72 |
| Every day/some days | | |

content, analysis, and response rates. A significant limitation of this study is that only individuals with current residential telephone service were included in the sample. A straight proportional design and similar content and analytic framework to that used in the 1996 Maryland study (10) was used in this study to facilitate comparability of results and to determine state-specific differences in response patterns. In addition, our estimates were similar to other statewide estimates with regard to prevalence of personal exposure to tobacco. There were no significant differences, for example, in our estimates of current cigarette smoking (23% ±3) and use of smokeless, chew, or snuff tobacco (5% ±1), in comparison to the 26 percent (±2) and 5 percent (±1), respectively, from Behavioral Risk Factor Surveillance System estimates for North Carolina in 2001 (11).

**Knowledge of Risk Factors and Signs.** One reason for only moderate improvement in US oral and pharyngeal cancer incidence rates since 1973 and for late diagnoses of oral cancer (2,12) may be the public's lack of knowledge about risk factors and early signs of oral cancer. Effective behavioral risk reduction strategies must begin with personal risk awareness. Although the American Cancer Society recommends that providers include health counseling about tobacco, sun exposure, diet and nutrition, risk factors, sexual practices, and environmental and occupational exposures during periodic cancer-related examinations for all adults (13), the extent to which busy professionals provide this counseling is unknown.

In addition to professional counseling, health knowledge may be gained from public media and health education pamphlets. Knowledge levels may be influenced by the scope and frequency of educational contacts. Unfortunately, information about oral cancer in magazines and newspapers over the last decade has been scant and at times inaccurate (14). Oral cancer educational materials (leaflets, brochure, fact sheets, and videos) distributed by national and state organizations and agencies are often written at a reading level too high for many target groups (15).

Public knowledge of signs of oral cancer has been assessed periodically at the national level. In the 1990 Health Promotion and Disease Prevention Supplement to the NHIS, only 25 percent correctly identified one early sign of oral cancer and 44 percent responded they did not know any signs (16). Knowledge of risk factors was also low, with only 36 percent correctly responding that excessive sunlight definitely increased the chance of getting lip cancer. Few knew that regular alcohol consumption increases the risk of oral cancer (15%), that eating hot spicy food definitely does not increase the chance of getting oral cancer (32%), and that frequently biting the cheek or lip does not increase the chance of getting mouth or lip cancer (16%) (16). In the 1992 NHIS, when asked about the causes of cancer, most adults 40 years and older correctly identified smoking (67%) and smokeless tobacco (59%), while few correctly identified sun exposure (18%) and alcohol (15%), and 77 percent incorrectly identified coffee (17). Level of knowledge was associated with level of education in this study.

In the 1996 Maryland survey, only 23 percent of the 85 percent of respondents who had ever heard of oral cancer could correctly identify one early sign (10), compared to 53 percent of the North Carolina population. While approximately 59 percent of Maryland adults were knowledgeable about two or more of the five risk factors, 97 percent of North Carolina adults had this level of knowledge; hence a higher risk factor knowledge score of four or more correct was chosen for the risk factor knowledge outcome. Specific knowledge variables that were more frequently answered correctly in North Carolina compared to Maryland include: regular alcohol drinking as a risk (49% in North Carolina and 13% in Maryland); sun exposure as a risk for lip cancer (63% in North Carolina and 36% in Maryland); eating hot and spicy foods as a nonrisk (82% in North Carolina and 32% in Maryland), and cheek biting as a nonrisk (65% in North Carolina and 16% in Maryland) (10).

Several possible explanations exist for the different knowledge levels determined in the Maryland and North Carolina surveys. These include a possible temporal trend in knowledge improvement, state-specific differences in educational systems and adult health care knowledge, and differences in wording of survey questions that may have influenced the interpretation of a correct response. The correct answer response coding of the North Carolina survey for knowing one early sign of oral cancer did not require the respondent to specify a nonpainful or nonhealing characteristic to the answer of red or white patch and sore or lesion, partially as a result of survey pretesting. Additionally, review of publicly available material promoting early detection of oral cancer from the National Oral Health Information Clearinghouse (18) does not make this distinction when listing possible signs and symptoms of oral cancer. In addition, the wording of the risk factor assessment question in the North Carolina study was simplified

**TABLE 5**
**Bivariate Analysis of Variables by Having Ever Had Oral Cancer Examination**

| Variable* | *n* | % Persons Who Have Had Exam | *P*-value |
|---|---|---|---|
| **Age (years)** | | | |
| 18–39 | 463 | 21.9 | |
| 40–64 | 428 | 35.2 | |
| ≥65 | 161 | 34.7 | **<.001** |
| Sex | | | |
| Male | 502 | 26.6 | |
| Female | 553 | 31.8 | .064 |
| Race | | | |
| White | 783 | 30.6 | |
| Black | 212 | 26.8 | |
| Other minorities | 37 | 24.2 | .439 |
| **Education (years)** | | | |
| ≤12 | 483 | 20.7 | |
| >12 | 572 | 36.6 | **<.001** |
| **Dentition status** | | | |
| Edentulous | 99 | 10.5 | |
| Dentate | 954 | 31.2 | **<.001** |
| Risk factor knowledge score | | | |
| 0–1 | 26 | 10.9 | |
| 2–3 | 437 | 30.7 | |
| 4–5 | 591 | 29.1 | .094 |
| Main cause of cancer | | | |
| Personal behaviors | 595 | 29.2 | |
| Environmental factors | 402 | 29.5 | .916 |
| Concern about cancer | | | |
| Very concerned | 240 | 28.7 | |
| Somewhat concerned | 609 | 29.6 | |
| Not concerned | 196 | 29.8 | .957 |
| **Smoke cigarettes** | | | |
| Every day/some days | 250 | 16.9 | |
| Not at all/never | 801 | 33.2 | **<.001** |
| Use of smokeless tobacco/chew/snuff | | | |
| Every day/some days | 55 | 17.8 | |
| Not at all/never | 998 | 30.0 | .051 |
| **Drink alcohol** | | | |
| Every day/some days | 480 | 33.0 | |
| Not at all/never | 573 | 26.3 | .017 |
| **Oral cancer sign knowledge** | | | |
| Know 1+ sign | 554 | 34.5 | |
| Know no signs | 499 | 23.6 | **<.001** |

*Significant variables in boldface.

to a two-level response (related or not related), rather than using the four-level response (definitely increasing, probably increasing, probably does not increase, or definitely does not increase) of the Maryland study (10), in response to confusion of pretest respondents over the original four-point scale and concern about this potentially resulting in measurement error.

**Experiences.** All health care providers have the opportunity to provide routine oral cancer examinations to their patients. The American Cancer Society currently recommends that a cancer-related check-up, including a case finding examination of the oral region, occur during a general periodic health examination for men and women aged 20 years and older (14). Despite high reported medical and dental attendance, only 23±2 percent of respondents aged 40 years and older reported having had an oral cancer examination within the last year. It is possible that this is an underestimate of the number of individuals who have actually had an oral mucosal exam to detect oral cancers. Although the phrasing of the question regarding receipt of an oral cancer examination has been consistently used throughout many national and state studies and is intended to create an image of the process rather than requiring the respondent to recall a discussion of the intent of the oral mucosal examination, the validity of the question is not known and likely has a high false negative rate. Providers might increase people's awareness of their receipt of an oral cancer examination by merely telling them they are being screened for oral cancer as the exam is conducted. In consideration of the US Preventive Services Task Force recommendation that "Clinicians should remain alert to signs and symptoms of oral cancer and premalignancy in persons who use tobacco or regularly use alcohol," (19) it is particularly distressing that tobacco users were significantly less likely to recall having ever received an oral cancer examination.

From previous surveys, we know that across the US there has been a low prevalence of oral cancer examinations. Data from the 1992 NHIS Cancer Control Supplement indicate that only 14.3 percent of the population 18 years of age and older had ever been examined for oral cancer (20). In this national cohort, lower prevalence of examinations was more likely among African Americans than whites, among Hispanics than non-Hispanics, and among current smokers than former smokers (20). Another analysis of national data limited to adults 40 years and older found that only 15 percent of the respondents reported ever having had an oral cancer examination (17). Examinations were more frequent among respondents who were white, above the poverty level, non-Hispanic, 40–64 years of age, had more than a high school education, and had knowledge about oral cancer risk factors (17).

The oral cancer examination rates of 28–29 percent reported in both the

**TABLE 6**
**Multivariable Logistic Regression Model for Having Ever Had Oral Cancer Examination ($n$=940)**

| Variable | Odds Ratio | 95% Confidence Interval |
|---|---|---|
| Age (years) | | |
| 18–39 (reference group) | 2.18 | 1.61, 2.95 |
| 40–64 | | |
| Dentition status | | |
| Edentulous (ref) | 3.87 | 1.89, 7.91 |
| Dentate | | |
| Cigarette smoking | | |
| Not at all/never (ref) | 0.44 | 0.30, 0.66 |
| Some days/every day | | |
| Alcohol | | |
| Not at all/never (ref) | 1.43 | 1.06, 1.94 |
| Some days/every day | | |
| Education (years) | | |
| >12 (ref) | 0.60 | 0.44, 0.82 |
| ≤12 | | |

statewide North Carolina and Maryland (10) phone surveys are higher than reported national rates in 1992 (17). Of explanatory factors explored in the Maryland and North Carolina surveys, only two factors were significantly associated with oral cancer examination history in both: higher levels of education and older age. Importantly, the effect of race found in Maryland was not apparent in North Carolina; however, dentate North Carolina residents and those who are nonsmokers were more likely to report having received an oral cancer examination. Our finding of an increased likelihood of having had an oral cancer examination among alcohol users than abstainers is consistent with the findings of the 1998 NHIS analysis of oral cancer examinations among adults at high risk (21).

We found that tobacco use is a well-recognized risk factor for oral cancer among the North Carolina public, and many, but not all, adults are aware of at least one early sign of oral cancer. Nevertheless, incidence and mortality rates remain high. Given the lack of association of race with knowledge of oral cancer risk factors and signs and with having ever had an oral cancer examination, we suggest that factors other than knowledge and examination experience, such as access to and quality of medical care, may influence the state's disproportionate oral cancer burden and poor outcomes (incidence and mortality) among North Carolina blacks. Other potential determinants for this racial disparity that warrant future exploration include: factors related to an individual's economic situation (access to routine medical and dental care, access to alcohol and tobacco cessation interventions, health care third party coverage, transportation), social and cultural beliefs/behaviors (social acceptance of alcohol and tobacco use, health care utilization patterns, personal coping mechanisms, disease denial and fatalism, aggressiveness of treatment recommendations by the provider, patient acceptance and compliance with treatment recommendations, family and community support during diagnosis, treatment, and follow-up), and general health status (host vulnerability, comorbidities, persistent use of alcohol and tobacco, aggressiveness of tumor type/histology).

In conclusion, although Maryland and North Carolina populations do not appear to be substantially different, noted differences between state survey responses support the concept of different state models to address oral cancer. Identified deficits in North Carolina health care provider's tobacco and alcohol use assessment need to be addressed by further research. It is important to acknowledge that tobacco smokers who are at higher risk, and for whom periodic oral examinations for cancer signs are recommended, are less likely to access this service than nonsmokers. Focusing public oral cancer education and examination efforts on tobacco users, those with less formal education, and the edentulous may have the largest impact on the state's future mortality rates for these cancers. Professional and lay educational campaigns must be combined with efforts to enhance risk prevention and improve access to examinations and support systems for treatment.

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