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Trends in incidence of oral and pharyngeal carcinoma in Florida: 1981–2008

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Abstract

Objective—While the overall incidence rates of oral and pharyngeal squamous cell carcinoma (SCC) have decreased in the United States, there is evidence of increasing incidence at selected anatomic sites, particularly among younger adults. The objective of this study was to examine trends in incidence rates of oral and pharyngeal cancers in Florida.

Methods—Using data from the Florida Cancer Data System, we examined the incidence of oral and pharyngeal carcinomas in Florida from 1981 through 2008. Factors of interest included sex, race, and trends over time. Percent change (PC) and annual percent change (APC) were computed to characterize trends over time.

Results—A total of 53,648 cases of oral or pharyngeal cancer were identified from 1981 through 2008. Significant increasing trends were observed only for pharyngeal cancers in males, with significant decreasing trends for pharyngeal cancer in females and oral cancer for both sexes. For tonsil and base of tongue cancers, increasing trends were detected for white males only. Further investigation among white males showed that, except for base of tongue cancer in the 20–44 age group, the incidence of both cancers increased across all age groups, with the largest increase for both sites found in the 45–64 age group.

Conclusions—This study supports the finding of increasing incidence of SCC of the tonsil and base of tongue in males, in contrast to decreasing trends for most oral and pharyngeal carcinomas. However, we observed that this increase occurred in white males only and the most dramatic increase occurred in the 45–64 age group.

Keywords

mouth neoplasms; pharyngeal neoplasms; human papillomavirus (HPV); incidence; trends

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Introduction

New cancers of the oral cavity and pharynx are the eighth most frequent type of cancer in males, with an estimated 36,540 new cases (25,420 for males) and 7,880 deaths (5,430 for males) reported in 2010 (1). Over the past two decades, the overall incidence of oral and pharyngeal squamous cell carcinoma (SCC) has decreased in the United States. This decreasing trend has been attributed to a decline in rates of smoking and alcohol consumption (2–4). In spite of an overall decrease in incidence, reports are showing an increased incidence of SCC at selected anatomic sites (5,6). For instance, Shiboski and colleagues reported a rising incidence, based on Surveillance, Epidemiology, and End Results Program (SEER) data from 1973 to 2001, of carcinomas in oral tongue, palatine tonsil, and base of tongue among 20- to 44-year-old white patients, but either a decrease or constancy at all other oral and pharyngeal sites (6).

Ryerson and colleagues reported that the most frequently cited risk factors for cancers of the pharynx and oral cavity were tobacco and alcohol, but current evidence also strongly implicated a role for human papillomavirus (HPV) (7–9). It is of note that there is a rising ascription in the literature of SCC of base of tongue and tonsil to oncogenic HPV (3), although this association is not universally accepted (10). Other authors pointed out that the detection of HPV infection did not prove that HPV was involved in the pathogenesis of the tumor (11). Still, the increased incidence of SCC at the base of tongue and tonsil is of concern. The role of HPV in head and neck cancers was further examined by Marur and colleagues, who noted that many questions regarding the natural history of oral HPV infection remain, with implications for cancer development, detection, and treatment (12). A more recent analysis of SEER incidence data grouped oral and pharyngeal cancers into HPV-related and HPV-unrelated sites (13). Among white men, HPV-related rates rose 62 percent, comparing 2003–2007 to 1977–1981. Rates for these sites declined in black males, but less rapidly than for HPV-unrelated sites.

It is not clear from the extant studies whether this trend toward an increased incidence of SCC is true among all adults, or whether differences exist by sex or by race, or whether it extends to other regions of the country not included in the SEER data. The SEER database, which includes limited information regarding the southeastern United States, has been shown not to be representative of the United States in some cases, particularly for smoking-related cancers (14). Hence, it is important to examine and contrast alternative data sources to identify potential regional differences. This study explores the trends in oral cavity and pharyngeal SCC from 1981 through 2008 using the Florida tumor registry data compiled from a large ethno-racially diverse state.

Methods

Data source

Data for patients diagnosed with oral or pharyngeal carcinoma between January 1, 1981, and December 31, 2008, were provided by the Florida Cancer Data System (FCDS), a statewide, population-based cancer registry (15). The FCDS was established by the State of Florida Department of Health (DOH) in 1978. It is maintained by the University of Miami Miller School of Medicine and supported by the state of Florida DOH and National Program of Cancer Registries of the Centers for Disease Control and Prevention. The FCDS collects cancer incidence data from hospitals, pathology laboratories, radiation therapy facilities, ambulatory surgical centers, and dermatopathologists' offices through 67 counties and covers 17,500,000 residents in Florida. Data used for this analysis were de-identified and included unduplicated cancer information for those with Florida residency at the time of diagnosis.

Oral and pharyngeal cancer cases and primary sites were identified using International Classification of Diseases (ICD)-O-3 codes (C00–C14) (16). We excluded salivary glands (C07.9–C08.9) from oral cancer and nasopharynx (C11.0–C11.9) from pharyngeal cancer, as cancers affecting these sites are generally not SCC (6). The oral cavity sites were categorized into five subgroups: oral tongue, lip, floor of mouth, palate, and other oral cavity (gum, cheek, mucosa, vestibule, retromolar area, and other unspecified parts of mouth). The pharyngeal sites were also categorized into five subgroups: tonsil, base of tongue, hypopharynx, oropharynx, and other unspecified pharynx. The cancer diagnosis in the FCDS data is based on histopathologic examination of the affected tissues.

Statistical analysis

Descriptive statistics were used to summarize the demographic characteristics of the population. Age-adjusted incidence rates were calculated as the primary outcome of this study. Age, sex, and race specific Florida population estimates from 1981 to 2008 were obtained from the Florida Consensus Estimating Conference, February 2009. Analyses were conducted by tumor primary site, sex, race, and age at diagnosis (20 to 44, 45 to 64, and >64 years). Age groupings were selected to examine specific time trends among those with young, intermediate, and older age at diagnosis. Trends of age-adjusted incidence rates of oral and pharyngeal cancers were evaluated using annual percentage change (APC), which was calculated by fitting a regression line to the natural logarithms of the age-adjusted incidence rates using calendar years as independent variables. The hypothesis that the APC was equal to zero was tested at the 0.05 significant level. A positive APC corresponds to an increasing trend, whereas a negative APC corresponds to a decreasing trend. Trends of age-adjusted incidence rates were also evaluated using percent change (PC). Percent change over a given time interval was calculated as $PC = [(Final\ value - Initial\ value)/Initial\ value] * 100$. A three-step analysis approach was followed. The initial analysis examined overall incidence trends in oral and pharyngeal cancers stratified by sex. Based on these results, for groups that demonstrated significant increasing rates, we examined incidence patterns for specific sites. Finally, trends in different age groups were examined for site and race combinations. All statistical analyses were conducted in SAS 9.2 (SAS Institute, Cary, NC, USA).

Representativeness of data

The validity of our estimates and conclusions depend on the quality and completeness of the data. Florida statutes require that all malignant cancers be reported to FCDS, with limited exceptions (such as some types of skin cancer). Data are collected at least quarterly by trained personnel (17). Case-finding strategies are implemented to insure completeness of the data, and changes have been made to capture the diagnosis and treatment of cancer in outpatient settings. FCDS has achieved the highest standard defined by the North American Association of Central Cancer Registries for quality, timeliness, and completeness of their data (18). Undiagnosed oral and pharyngeal cancers could differentially impact our estimates, as it has been shown that racial differences exist with regard to stage at diagnosis (19,20).

Results

Table 1A displays the demographic characteristics for 53,648 subjects identified with new cases of oral or pharyngeal cancer in Florida from 1981 through 2008. Over two thirds of these cancers occurred in males, with approximately 90 percent occurring in white individuals. Relatively few cancers (6 percent) were diagnosed in those younger than 45 years of age, with the majority (50 percent) occurring in those older than 64. As seen in Table 1B, the proportions of oral cavity and pharyngeal SCC cases were very close among

whites (49 percent and 51 percent, respectively), whereas there was a larger proportion of pharyngeal SCC cases (60 percent) among blacks. There were consistently more pharyngeal cancer cases than oral cancer cases among black individuals across all three age groups, with the largest discrepancy between these two cancers found in the intermediate age group (63 percent and 37 percent, respectively). The intermediate age group (age 45–64) also had more pharyngeal cancer cases among white individuals, whereas there were more oral cancers in the younger (age 20–44) and older (age 64+) age groups (Table 1B).

Figure 1 illustrates the distribution of specific cancers of the oral cavity and pharyngeal sites by age at diagnosis. For those diagnosed at a younger age, the primary sites were oral tongue and lip for the oral cavity sites, and tonsil and base of tongue for the pharyngeal sites. These sites accounted for a smaller proportion of cancers in the older age groups. Figure 2 displays the age-adjusted incident rates of oral cavity and pharyngeal sites by sex. The APC was positive for only one category: pharyngeal cancers in males (APC = 0.91; 95 percent CI: 0.64–1.18), where the age-adjusted incidence rate increased from 8.0 in 1981 to 9.6 in 2008 (PC = 20.2). Significant negative trends were detected for pharyngeal sites in females and oral cavity sites for both males and females.

Cancers in tonsil and base of tongue together accounted for more than 60 percent of all pharyngeal cancer cases in our data. During 1981 to 2008, the incidence rates for both tonsil and base of tongue cancers increased among white males with APCs of 2.84 (95 percent CI: 2.35–3.33) and 2.72 (95 percent CI: 2.31–3.13), respectively, while among black males, the incidence rates were decreasing with APCs of –2.46 (95 percent CI: –3.35 to –1.56) and –2.68 (95 percent CI: –4.15 to –1.18), respectively (Table 2). Further examination of trends by age groups showed that, for tonsil cancer, significant positive changes were observed for all three age groups in white males, with the younger (PC = 24.0; APC = 4.64, 95 percent CI: 3.18–6.14) and intermediate (PC = 165.9; APC = 3.66, 95 percent CI: 3.01–4.31) age groups having the largest change (Figure 3). For cancers of the base of the tongue, the intermediate group again had the largest change in cancer incidence (PC = 158.6; APC = 3.58, 95 percent CI: 2.89–4.27), followed by the oldest age group (PC = 74.4; APC = 1.84, 95 percent CI: 1.26–2.42). No statistically significant change was observed for the younger age group (Figure 4).

As a secondary analysis, we also examined the incidence of oral tongue cancer in our data. Overall, we did not detect a significant change in incidence rate among males. However, race comparisons revealed a significant increase in white males (APC = 0.59, 95 percent CI: 0.14–1.04), and a significant decrease in black males (APC = –3.43, 95 percent CI: –5.14 to –1.70). Further stratification by age groups revealed a significant increased incidence for white males in the younger age group and decreased rates for black males in the younger and intermediate age groups (data not shown).

Discussion

Our study showed that there was an unexpected increase in the incidence of pharyngeal cancer among males in Florida from 1981 to 2008. Further analyses on the two most frequently diagnosed pharyngeal cancers, tonsil and base of tongue cancers, revealed that this increase occurred only in white males. After a more detailed analysis by age groups, we found that in white males, incidence of tonsil cancer increased across all three age groups, while incidence of base of tongue cancer increased in the age 45–64 and 64+ groups. For both sites, the largest increase in cancer incidence was among the intermediate age group (age 45–64).

SEER data include registries from five states (Connecticut, Hawaii, Iowa, New Mexico, Utah), and six metropolitan areas (Atlanta, Detroit, San Francisco/Oakland, Seattle/Puget Sound, San Jose/Monterey, Los Angeles County) (21). Despite the differences in population sources and timeframe, the demographic characteristics, incidence rates, and trends in our data were generally similar to the SEER-based results presented by Shiboski *et al.* (6). Pharyngeal cancers accounted for a larger proportion of oral or pharyngeal cancers in our database (52 percent) compared to the SEER data (35 percent). For both sets of data, the 20–44 age group accounted for 7 percent of the oral cancers and 5 percent of the pharyngeal cancers. In the Florida 20 to 44 age group, 84 percent were white and 14 percent were black, compared to 76 percent and 18 percent, respectively, in the SEER analysis. Also, it is worth noting that more pharyngeal cancer cases than oral cancer cases were reported in our data among black individuals only (Table 1B). A similar observation was reported by Shiboski *et al.* for the younger age group in the SEER data (6). Age-adjusted incidence rates tended to be higher in Florida with rates of 8 to 10 per 100,000 for males with pharyngeal cancer, compared to 5 to 7 per 100,000 in the SEER-based analysis. Analyses of both datasets revealed significant decreasing trends for oral and pharyngeal cancers in females and oral cancers in males over the years studied. We, however, detected a significant increase in incidence in pharyngeal cancers in males (APC = 0.9, $P < 0.0001$), while the SEER data did not reveal a similar change (APC = 0.1, $P = 0.50$).

Shiboski and colleagues reported a significant increase in the incidence of tonsil and base of tongue carcinomas among younger white individuals (6). Therefore, we focused our study on these two cancers that were also the most frequently diagnosed pharyngeal cancers in our data. Further investigation showed that the increase in incidence of these pharyngeal cancers occurred in white males only. The incidence was found to be decreasing among black males. During 1981 and 2008, the incidence rates for both tonsil and base of tongue cancers significantly increased among white males with APCs of 2.84 and 2.72, respectively. On the other hand, among black males, the incidence rates were significantly decreasing with APCs of –2.46 and –2.68, respectively. This race difference was also observed for the incidence of tongue cancer. There was a decreasing trend in tongue cancer incidence in black males while an increasing trend was observed in white males (data not shown). The increasing trend in incidence of pharyngeal cancers in white males appeared to be driven by the increase in HPV-related cancers in the past few decades (22). Studies have shown that the increasing prevalence of HPV in oropharyngeal cancers was associated with changes in sexual behaviors, including increasing exposures to oral sex and multiple sexual partners (23,24). It has been reported that white individuals were more likely to engage in these sexual activities, which elevated their risk of getting oral or pharyngeal cancers than black individuals (25). Watson *et al.* examined racial and ethnic differences in HPV-associated cancers in women from 1999 through 2004 (26). Patterns noted were somewhat similar to our findings, with a more significant decrease in APC for black women for cervical carcinoma (black APC –5.11, white APC –4.00) and vaginal carcinoma (black APC –6.21, white –1.40). However, for both types of cancer, incidence rates were higher for black women than for white women over the entire time period. The pattern for vulvar squamous cell carcinoma differed, with white women more likely to be affected, and the incidence rate constant over time (APC –0.13), but the incidence for black women was increasing (APC 2.88).

To better explore the relationship between age at diagnosis and pattern of change, we then examined cancer incidence rates in three different age groups among white males. For tonsil carcinoma, significant positive changes were observed for all three age groups in white males, with the younger (PC = 24.0; APC = 4.64) and intermediate (PC = 165.9; APC = 3.66) age groups having the largest changes. A similar observation was made for tonsil cancer in white males of in the 20–44 age group (PC = 41; APC = 3.9) by Shiboski *et al.* (6).

For base of tongue carcinoma, the intermediate age group again had the highest increase in cancer incidence (PC = 158.6; APC = 3.58), followed by the older age group (PC = 74.4; APC = 1.84), while the younger group had no statistically significant changes. Shiboski and colleagues did not observe a significant change in incidence of base of tongue cancer for the same age group in their study (6). However, the reason for these findings could be that cancer of the base of tongue is usually diagnosed at later stages since it occurs in a region that is difficult to visualize, unlike other parts of the mouth. In addition, cancer misclassification during diagnosis is possible due to the anatomical complexity of that region which includes Waldeyer's ring (27). It is of interest to note that the largest increase occurred in the intermediate age group for both cancers. The time frame for the two studies differs by 8 years, so a portion of the initial 20- to 44-year-old cohort would have advanced to the intermediate age group.

Several studies have detected an increase in incidence of oral tongue cancer (6,28). Our study showed that there was no statistically significant change in the incidence rate of this type of cancer among males. However, a significant increase in incidence was observed in white males (APC = 0.59), while a significant decrease was observed in black males (APC = -3.43). Further study showed that the significant increase in incidence for white males was in the younger age group, which is consistent with the observation made by Shiboski *et al.* (6).

Several risk factors have been identified for oral and pharyngeal cancers, including tobacco and alcohol exposure and socioeconomic status (29). There is also a clear association or relationship with HPV for a subset of SSC, especially those associated with lymphatic tissue in the Waldeyer's ring such as tonsil and base of tongue cancers (12,30,31). HPV-associated or -related oral cancers appear distinct, and differences have been observed in treatment response and survival, with worse outcomes for HPV-negative disease. Questions remain regarding detection of HPV in tumors and differential sex-specific associations, and little is known regarding the epidemiology of oral HPV infections (12). The proportion of HPV-associated oropharyngeal cancers varies widely, depending on the population being studied and the detection method used (30). As HPV is a sexually transmitted disease, it is not surprising that sexual behavior characteristics were shown to be associated with oropharyngeal cancers after adjusting for age, sex, tobacco and alcohol use, oral health behavior, and family history (30).

Our findings of increasing incidence of certain oral and pharyngeal cancers among particular groups of individuals in Florida provide a basis for future research which could focus on identification of potential risk factors for these groups. Prevention and screening activities could then be targeted for these groups of individuals. Spatial analysis using disease mapping is one of the techniques that could be used to identify areas of high risk and study geographical associations among cancers (32). Spatial modeling could also be performed to identify risk factors associated with high-risk areas based on individual and geographical information (33).

In summary, we identified an overall increasing incidence trend of pharyngeal SCC in males in Florida from 1981 to 2008. Incidence of tonsil and base of tongue SCC was rising in white males, while decreasing trends were observed in black males. For both cancers, the most dramatic increase occurred in the intermediate age group (age 45–64) in white males. Our study supports the findings of previous studies using different data sources of an increasing trend in tonsil and base of tongue SCC in white males.

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References

1. American Cancer Society. [accessed February 28, 2011] Cancer Facts & Figures 2010. 2010. Available from: <http://www.cancer.org/Research/CancerFactsFigures/index>
2. Polednak AP. Trends in incidence rates of tobacco-related cancer, selected areas, SEER Program, United States, 1992–2004. *Prev Chronic Dis*. 2009; 6:A16. [PubMed: 19080022]
3. Sturgis EM, Cinciripini PM. Trends in head and neck cancer incidence in relation to smoking prevalence: an emerging epidemic of human papillomavirus-associated cancers? *Cancer*. 2007; 110:1429–1435. [PubMed: 17724670]
4. Brown LM. Epidemiology of alcohol-associated cancers. *Alcohol*. 2005; 35:161–168. [PubMed: 16054977]
5. Canto MT, Devesa SS. Oral cavity and pharynx cancer incidence rates in the United States, 1975–1998. *Oral Oncol*. 2002; 38:610–617. [PubMed: 12167440]
6. Shiboski CH, Schmidt BL, Jordan RC. Tongue and tonsil carcinoma: increasing trends in the U.S. population ages 20–44 years. *Cancer*. 2005; 103:1843–1849. [PubMed: 15772957]
7. Mendenhall WM, Logan HL. Human papillomavirus and head and neck cancer. *Am J Clin Oncol*. 2009; 32:535–539. [PubMed: 19652580]
8. Ritchie JM, Smith EM, Summersgill KF, Hoffman HT, Wang D, Klusmann JP, Turek LP, Haugen TH. Human papillomavirus infection as a prognostic factor in carcinomas of the oral cavity and oropharynx. *Int J Cancer*. 2003; 104:336–344. [PubMed: 12569557]
9. Ryerson AB, Peters ES, Coughlin SS, Chen VW, Gillison ML, Reichman ME, Wu X, Chaturvedi AK, Kawaoka K. Burden of potentially human papillomavirus-associated cancers of the oropharynx and oral cavity in the US, 1998–2003. *Cancer*. 2008; 113(10 Suppl):2901–2909. [PubMed: 18980273]
10. Salem A. Dismissing links between HPV and aggressive tongue cancer in young patients. *Ann Oncol*. 2010; 21:13–17. [PubMed: 19825879]
11. Hennessey PT, Westra WH, Califano JA. Human papillomavirus and head and neck squamous cell carcinoma: recent evidence and clinical implications. *J Dental Res*. 2009; 88:300–306.
12. Marur S, D'Souza G, Westra WH, Forastiere AA. HPV-associated head and neck cancer: a virus-related cancer epidemic. *Lancet oncol*. 2010; 11:781–789. [PubMed: 20451455]
13. Brown LM, Check DP, Devesa SS. Oropharyngeal cancer incidence trends: diminishing racial disparities. *Cancer Causes Control*. 2011; 22:753–763. [PubMed: 21380619]
14. Merrill RM, Dearden KA. How representative are the surveillance, epidemiology, and end results (SEER) program cancer data of the United States? *Cancer Causes Control*. 2004; 15:1027–1034. [PubMed: 15801487]
15. [accessed February 28, 2011] Florida cancer data system. 2011. Available from: <http://fcfs.med.miami.edu/>
16. Fritz, A.; Percy, C.; Jackson, K., editors. International classification of diseases for oncology. 3rd ed.. Geneva: World Health Organization; 2000.
17. [accessed February 28, 2011] Florida cancer data system questions. 2011. Available from: <http://fcfs.med.miami.edu/inc/questions.shtml>
18. Surendera, BA.; Johnson, TM.; Hylton, TN.; Huang, Y.; Button, JH.; Wohler, B.; Levin, GM.; MacKinnon, J.; Fleming, LE. Florida annual cancer report: 2006 incidence and mortality. Tallahassee: Florida Department of Health; 2011. Available from: http://www.doh.state.fl.us/disease_ctrl/epi/cancer/AnnualReport06.pdf
19. Shiboski CH, Schmidt BL, Jordan RC. Racial disparity in stage at diagnosis and survival among adults with oral cancer in the US. *Community Dent Oral Epidemiol*. 2007; 35:233–240. [PubMed: 17518970]

20. Tomar SL, Loree M, Logan HL. Racial differences in oral and pharyngeal cancer treatment and survival in Florida. *Cancer Causes Control*. 2004; 15:601–609. [PubMed: 15280639]
21. National Cancer Institute. [accessed February 28, 2011] Surveillance epidemiology and end results. 2011. Available from: <http://www.seer.cancer.gov/>
22. Gillison ML. Current topics in the epidemiology of oral cavity and oropharyngeal cancers. *Head Neck*. 2007; 29:779–792. [PubMed: 17230556]
23. Mosher WD. Sexual behavior and selected health measures: men and women 15–44 years of age, United States 2002. *Adv Data*. 2005; 362:1–55. [PubMed: 16250464]
24. Smith EM. Age, sexual behavior and human papillomavirus infection in oral cavity and oropharyngeal cancers. *Int J Cancer*. 2004; 108:766–772. [PubMed: 14696105]
25. Brawley OW. Oropharyngeal cancer, race, and the human papillomavirus. *Cancer Prev Res (Phila)*. 2009; 2:769–772. [PubMed: 19641041]
26. Watson M, Saraiya M, Wu X. Update of HPV-associated female genital cancers in the United States, 1999–2004. *J Womens Health (Larchmt)*. 2009; 18:1731–1738. [PubMed: 19951205]
27. Tan LH. Lymphomas involving Waldeyer's ring: placement, paradigms, peculiarities, pitfalls, patterns and postulates. *Ann Acad Med Singapore*. 2004; 33(4 Suppl):15–26. [PubMed: 15389302]
28. Schantz SP, Yu GP. Head and neck cancer incidence trends in young Americans, 1973–1997, with a special analysis for tongue cancer. *Arch Otolaryngol Head Neck Surg*. 2002; 128:268–274. [PubMed: 11886342]
29. Johnson S, McDonald JT, Corsten M, Rourke R. Socio-economic status and head and neck cancer incidence in Canada: a case-control study. *Oral Oncol*. 2010; 46:200–203. [PubMed: 20138799]
30. D'Souza G, Kreimer AR, Viscidi R, Pawlita M, Fakhry C, Koch WM, Westra WH, Gillison ML. Case-control study of human papillomavirus and oropharyngeal cancer. *N Engl J Med*. 2007; 356:1944–1956. [PubMed: 17494927]
31. Vu HL, Sikora AG, Fu SB, Kao J. HPV-induced oropharyngeal cancer, immune response and response to therapy. *Cancer Lett*. 2010; 288:149–155. [PubMed: 19628331]
32. Onicescu G, Hill EG, Lawson AB, Korte JE, Gillespie MB. Joint disease mapping of cervical and male oropharyngeal cancer incidence in blacks and whites in South Carolina. *Spat Spattemporal Epidemiol*. 2010; 1:133–141.
33. Nieder AM, MacKinnon JA, Fleming LE, Kearney G, Hu JJ, Sherman RL, Huang Y, Lee DJ. Bladder cancer clusters in Florida: identifying populations at risk. *J Urol*. 2009; 182:46–50. [PubMed: 19450849]

Figure 1.
Oral and pharyngeal squamous cell carcinoma incidence cases, in Florida, 1981–2008:
distribution by age and site.

*** M, Oral Cavity; PC= -44.9; APC= -1.80, P< 0.0001
 ○-○ M, Pharynx; PC= 20.2; APC= 0.91, P< 0.0001
 △-△ F, Oral Cavity; PC= -43.1; APC= -1.55, P< 0.0001
 +--+ F, Pharynx; PC= -24.3; APC= -0.90, P< 0.0001

Figure 2.
 Trends in age-adjusted incident rates of oral cavity and pharyngeal carcinoma among adults by sex, in Florida, 1981–2008 (M = male, F = female).

*** Age 20-44: PC= 24.0; APC= 4.64, $p < 0.0001$
 ○○ Age 45-64: PC= 165.9; APC= 3.66, $p < 0.0001$
 ▲▲ Age 64+: PC= -9.6; APC= 0.82, $p = 0.0009$

Figure 3.
 Trends in age-adjusted incident rates of tonsil for white male by age group, in Florida,
 1981–2008.

*** Age 20-44: PC= 36.8; APC= 1.96, p= 0.058
 ○○ Age 45-64: PC= 158.6; APC= 3.58, p< 0.0001
 ▲▲ Age 64+: PC= 74.4; APC= 1.84, p< 0.0001

Figure 4.
Trends in age-adjusted incident rates of base of tongue for white male by age group, in Florida, 1981–2008.

Table 1

Distribution of Incidence of Oral and Pharyngeal Cancer Cases by Sex, Race, or Age at Diagnosis, in Florida, 1981–2008

(A)				
Characteristics	Total <i>n</i> = 53,648	Oral cavity <i>n</i> = 26,017	Pharynx <i>n</i> = 27,631	
Sex				
Male	36,576 (68%)	16,240 (62%)	20,336 (74%)	
Female	17,050 (32%)	9,768 (38%)	7,282 (26%)	
Race				
White	48,386 (91%)	23,796 (92%)	24,590 (90%)	
Black	4,488 (8%)	1,808 (7%)	2,680 (10%)	
Other	327 (1%)	175 (1%)	152 (0%)	
Age at diagnosis				
20–44	3,244 (6%)	1,873 (7%)	1,371 (5%)	
45–64	23,781 (44%)	10,121 (39%)	13,660 (49%)	
64+	26,623 (50%)	14,023 (54%)	12,600 (46%)	
(B)				
Race	Age 20–44	Age 45–64	Age 64+	Total
White				
Oral cavity	1,610 (59%)	8,949 (43%)	13,237 (53%)	23,796 (49%)
Pharynx	1,103 (41%)	11,816 (57%)	11,671 (47%)	24,590 (51%)
Black				
Oral cavity	213 (47%)	987 (37%)	608 (44%)	1,808 (40%)
Pharynx	241 (53%)	1656 (63%)	783 (56%)	2,680 (60%)

Estimated Annual Percentage Change for Incidence of Tonsil and Base of Tongue Cancers among Males, in Florida, 1981–2008

Table 2

Site	Race	Estimated annual percentage change (95% confidence interval)			
		Overall	Age 20–44	Age 45–64	Age 64+
Tonsil	All races	2.16 (1.71, 2.61)	2.58 (1.17, 4.00)	2.90 (2.29, 3.51)	0.66 (0.11, 1.22)
	White	2.84 (2.35, 3.33)	4.64 (3.18, 6.14)	3.66 (3.01, 4.31)	0.82 (0.22, 1.42)
	Black	−2.46 (−3.35, −1.56)	−6.04 (−8.97, −3.02)	−2.14 (−3.27, −0.99)	−0.87 (−3.00, 1.31)
Base of Tongue	All races	2.15 (1.76, 2.55)	−0.25 (−1.73, 1.25)	2.86 (2.26, 3.46)	1.62 (1.05, 2.19)
	White	2.72 (2.31, 3.13)	1.96 (−0.07, 4.04)	3.58 (2.89, 4.27)	1.84 (1.26, 2.42)
	Black	−2.68 (−4.15, −1.18)	−6.32 (−9.09, −3.47)	−2.61 (−4.49, −0.68)	−1.56 (−4.42, 1.38)