

Descriptive Epidemiology: U.S. Patterns

Linda Morris Brown, Gloria Gridley, and Susan S. Devesa

Abbreviations

US	United States
HN	head and neck
SEER	Surveillance, Epidemiology, and End Results
HPV	Human Papillomavirus
ICD-O-3	International Classification of Diseases for Oncology, third edition
API	Asian/Pacific Islander
AI/AN	American Indian/Alaskan Native

Overview

According to 2009 estimates provided by the American Cancer Society, approximately 35,160 men and 12,850 women are expected to be diagnosed with cancers of the oral cavity, pharynx, and larynx in the United States, and approximately 8,140 men and 3,120 women are expected to die from these cancers [1]. This chapter reviews the descriptive patterns of squamous cell carcinomas of the oral cavity, pharynx, and larynx. Tabulations of cancers of the oral cavity and pharynx usually include those of the lip, tongue, gums, floor of the mouth, hard and soft palate, salivary glands, tonsils, oropharynx, hypopharynx, and nasopharynx. For this analysis, we have excluded cancers of the lip, salivary glands, and nasopharynx since salivary

L.M. Brown (✉)

RTI International, 6110 Executive Blvd, Suite 902, Rockville, MD, 20852-3907, USA
e-mail: lindabrown@rti.org

G. Gridley and S.S. Devesa

Division of Cancer Epidemiology and Genetics, National Cancer Institute,
National Institutes of Health, Department of Health and Human Services, 6120 Executive Blvd,
Bethesda, MD, 20892-7244, USA
e-mail: devesas@mail.nih.gov; gridleyg@aol.com

gland cancers are primarily adenocarcinomas, and tumors of the lip and nasopharynx have etiologic profiles that differ from those of the other head and neck (HN) cancers. We also excluded sarcomas, lymphomas, and other nonsquamous cell carcinomas because it is likely that they are also etiologically distinct.

Methods

Data from population-based registries in the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program [2] were used to calculate incidence and survival rates. Primary site and histologic type have been coded according to the International Classification of Diseases for Oncology, third edition [ICD-O-3] [3]. We selected all cases of invasive squamous cell carcinoma (morphology codes 8050-8084) of the oral cavity (topography codes C019-C069), pharynx (codes C090-C109, C129-C148), and larynx (codes C320-C329). For selected analyses, we divided cancers of the oral cavity and pharynx into three categories based on human papillomavirus (HPV) status: HPV-related cancers (codes C019 – base of tongue, C024 – lingual tonsil, C090-C109 – tonsil and oropharynx, C142 – Waldeyer ring), HPV-unrelated cancers (codes C020-C023 and C025-069 – other tongue except lingual tonsil, gum, floor of mouth, palate, other and unspecified parts of mouth), and HPV role unknown (C129-C140, C148 – pyriform sinus, hypopharynx, pharynx, overlapping oral cavity and pharynx) [4].

Age-adjusted incidence rates (using the 2000 U.S. standard) and age-specific rates (5-year age groups) per 100,000 person-years were calculated separately for each site and for all three sites combined by sex and race using SEER*Stat [5]. Five-year relative survival rates were calculated by time period of diagnosis (1975–1984, 1985–1994, and 1995–2003, with follow-up through 2004) and stage (localized, regional, distant, and unknown using SEER historic stage A). Relative survival rates take into account the expected mortality for a comparable race-, sex-, age- and time period-specific cohort and are expressed as percentages. Data from the original nine SEER registries (SEER 9) were utilized for analysis of long-term incidence and survival rates among whites and blacks; these nine registries account for approximately 10% of the U.S. population and are located in the metropolitan areas of Atlanta, Detroit, San Francisco-Oakland, and Seattle-Puget Sound and the states of Connecticut, Hawaii, Iowa, New Mexico, and Utah [6]. The SEER program was expanded in 1992 to include four additional registries for a total of 13 registries (SEER 9 plus the California metropolitan areas of San Jose-Monterey and Los Angeles, several counties in rural Georgia, and the Alaska Native Tumor Registry) [7]. The populations in these 13 areas account for 14% of the U.S. population and include substantial numbers of Asian/Pacific Islanders (APIs) and Hispanics.

National vital statistics data for 1950–2004 from the National Center for Health Statistics were used to calculate long-term mortality rates for each site by race and sex. We selected all deaths due to oral cavity cancer (excluding lip and salivary

glands), pharynx cancer (excluding nasopharynx), and larynx cancer; all histologic types are included because histology is generally not reported on the death certificate and is not coded even if specified.

Only data points representing populations with at least 10 cases were presented. All temporal trends were plotted such that a slope of 10° represented a change of 1% per year (i.e., 40 years on the horizontal axis is the same length as one logarithmic cycle on the vertical axis) [8].

Demographic Patterns

Incidence

During the period 1992–2004, more than 48,000 HN cancers were diagnosed among residents of the 13 SEER registries (Table 1). Forty-three percent of HN tumors occurred in the oral cavity, 34% in the larynx, and 24% in the pharynx. The tongue and tonsil were the predominant specific sites in the oral cavity and pharynx, respectively. Among laryngeal cancers, the glottis was more frequent than the supraglottis among males but not among females. All HN cancers combined occurred 3–4 times more frequently among men than women. Among white non-Hispanics, the male/female rate ratios ranged from 2.2 for oral cavity to 3.4 for pharynx and 4.5 for larynx cancers. The male/female rate ratios were all larger among blacks, ranging from 3.2 for oral cavity to 4.4 for pharynx and 5.0 for larynx; the ratios among APIs and Hispanics, frequently, were even greater due to relatively low rates among the women. Incidence rates were higher among blacks than white non-Hispanics for most sites, especially among males. The black/white non-Hispanic rate ratio among males was 1.52 for all HN cancers combined and ranged from 1.21 for oral cavity to 1.70 for pharynx and 1.72 for larynx cancers. The highest rate among white non-Hispanic men was for cancer of the oral cavity (7.1), whereas the highest rate for black men was for cancer of the larynx (11.5). Rates for American Indian/Alaska Native (AI/AN), API, and Hispanic men were generally 33–50% lower than for white non-Hispanic men. Among females, oral cavity rates were 18% lower among blacks than white non-Hispanics due primarily to the higher rates of tongue cancer among white non-Hispanic women; in contrast, pharynx and larynx cancer rates were 31% and 53% higher among blacks than white non-Hispanics, respectively. Rates for AI/AN, API, and Hispanic women were considerably lower than for white non-Hispanic women.

Age-Specific Patterns

Age-specific incidence rates in the SEER 13 registries during 1992–2004 rose exponentially among males and females of each racial/ethnic group for all three sites until at least the age of 60 (Fig. 1). Among males, oral cavity cancer rates

Table 1 Incidence rates of squamous cell carcinoma of the oral cavity, pharynx, and larynx by race/ethnicity, sex, and site, 1992–2004, SEER 13^{a,b,c}

	White non-Hispanic		Black		American Indian/ Alaska Native ^d		Asian/ Pacific Islander		Hispanic– Latino ^e	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Males										
All three sites	26,118	18.2	4,760	27.6	136	10.7	1781	9.1	2,356	12.0
Oral cavity	10,175	7.1	1,534	8.6	56	4.2	707	3.6	773	3.8
Tongue	5,837	4.0	756	4.3	30	2.0	435	2.2	410	2.0
Floor of mouth	1,860	1.3	348	1.9	13	1.2	70	0.4	169	0.8
Gum and other mouth	2,478	1.8	430	2.5	13	1.0	202	1.0	194	1.0
Pharynx	6,351	4.4	1,333	7.5	38	3.2	462	2.3	619	3.0
Tonsil	3,236	2.2	560	3.1	13	1.0	201	1.0	288	1.3
Oropharynx	659	0.5	193	1.1	3	–	24	0.1	69	0.3
Hypopharynx	1,903	1.3	464	2.7	20	1.8	211	1.1	215	1.2
Other oral cavity and pharynx	553	0.4	116	0.7	2	–	26	0.1	47	0.2
Larynx	9,592	6.7	1,893	11.5	42	3.3	612	3.2	964	5.2
Glottis	5,820	4.1	956	6.0	24	1.9	389	2.1	606	3.3
Supraglottis	2,803	1.9	617	3.7	11	0.8	149	0.8	230	1.2
Other and unspecified	969	0.7	320	1.9	7	–	74	0.4	128	0.7
Females										
All three sites	10,608	6.1	1,519	6.7	52	3.5	691	2.9	720	3.0
Oral cavity	5,921	3.3	618	2.7	36	2.4	503	2.1	428	1.8
Tongue	2,863	1.7	288	1.2	15	1.0	313	1.3	237	0.9
Floor of mouth	911	0.5	116	0.5	11	0.7	36	0.2	53	0.2
Gum and other mouth	2,147	1.2	214	1.0	10	0.7	154	0.7	138	0.6
Pharynx	2,158	1.3	386	1.7	9	–	96	0.4	122	0.5
Tonsil	1,017	0.6	165	0.7	2	–	58	0.2	75	0.3
Oropharynx	271	0.2	52	0.2	0	–	7	–	13	0.1
Hypopharynx	617	0.4	124	0.5	6	–	29	0.1	29	0.1
Other oral cavity and pharynx	253	0.1	45	0.2	1	–	2	–	5	–
Larynx	2,529	1.5	515	2.3	7	–	92	0.4	170	0.7
Glottis	953	0.6	136	0.6	1	–	41	0.2	81	0.3
Supraglottis	1,295	0.8	299	1.3	5	–	40	0.2	65	0.3
Other and unspecified	281	0.2	80	0.4	1	–	11	0.0	24	0.1

^aRates are per 100,000 person-years and age-adjusted to the 2000 US Standard Population (19 age groups)

^bExcludes lip, salivary gland, and nasopharynx cancers

^cRate subtotals may differ from the sum of the components due to rounding and/or suppression

^dContract Health Service Delivery Area (CHSDA) counties only

^e12 SEER areas (excluding Alaska)

Rate not shown because fewer than 10 cases

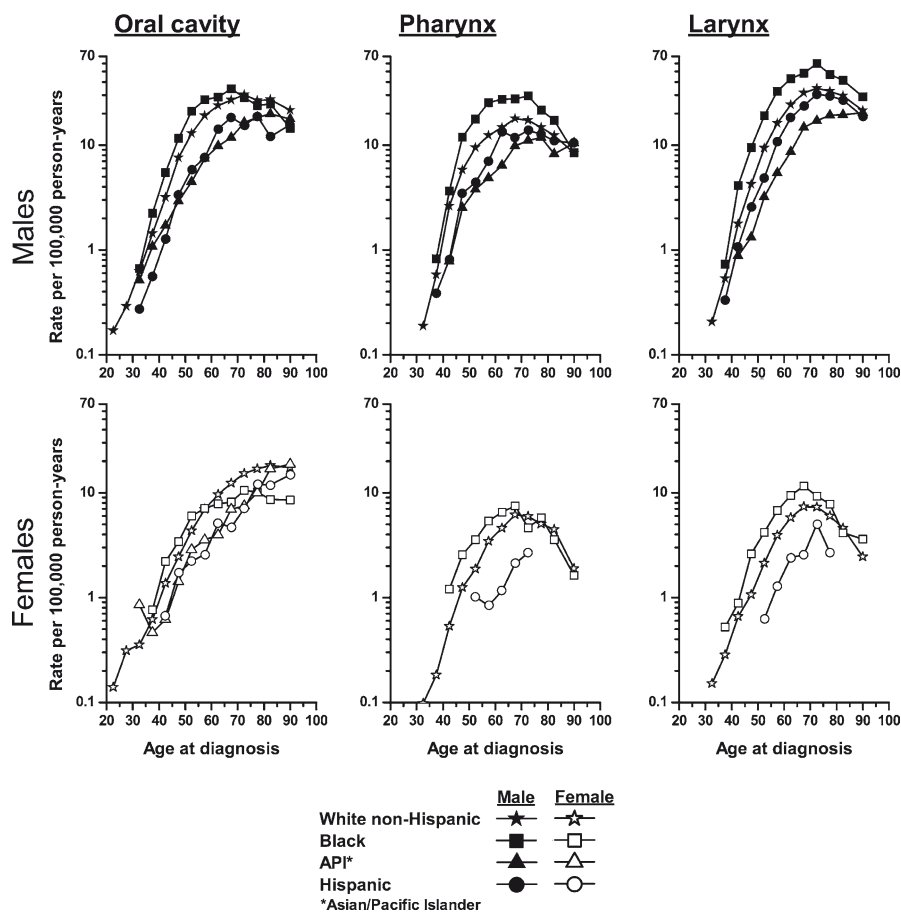


Fig. 1 Age-specific incidence rates of oral cavity, pharynx, and larynx squamous cell carcinoma by sex and race/ethnicity during 1992–2004, SEER 13 (excludes lip, salivary gland, and nasopharynx cancers)

dropped off at the older ages but were higher among blacks than white non-Hispanics at all but ages 70 and older. Rates among API and Hispanic men were similar at all ages but were lower than those among white non-Hispanics. Similar to cancer of the oral cavity, pharynx and larynx cancer rates among males rose with age before dropping off at the older ages. Blacks had the highest pharynx cancer rates, followed by white non-Hispanics, at all ages except for the oldest (85+). API males had the lowest rates at virtually all ages. The declines in incidence rates with age were especially pronounced among blacks and white non-Hispanics for both pharynx and larynx cancers and among Hispanics for larynx cancer. The black/white non-Hispanic differences were most pronounced across the middle age groups for pharynx cancer and the least for oral cavity cancer.

Among females, oral cancer rates generally increased with age for all race groups (Fig. 1). In contrast to males, blacks had the highest rates only at younger ages (<60) and white non-Hispanics had the highest rates at ages 60–84. Oral cancer rates plateaued at older ages among blacks and white non-Hispanics but continued to rise with age among APIs and Hispanics. As a result, rates among Hispanics and APIs were higher than those among blacks at the older ages. The patterns for larynx and pharynx cancers were distinctly different, with the highest rates among white non-Hispanics and blacks at ages 65–69, followed by dramatic declines at older ages. Rates were notably higher among blacks than white non-Hispanics at virtually all ages for larynx cancer but only at ages <70 years for pharynx cancer. Hispanic women had the lowest rates for these two cancers. The numbers of pharynx and larynx cases among API women were too small to graph.

Time Trends

The temporal incidence trends for the HN cancers varied considerably by site, sex, and race/ethnicity (Fig. 2). Age-adjusted incidence rates per 100,000 for oral cavity cancer among black men peaked at 13.3 in 1980–1984 and then began a marked 45% decline, reaching 7.3 in 2000–2004. Rates among white men also peaked in 1980–1984 at 8.1 per 100,000 but had a more gradual 17% decline to 6.7 and 6.8 in 1995–1999 and 2000–2004, respectively. Rates among API, AI/AN, and Hispanic men all declined between 1995–1999 and 2000–2004. Although rates of oral cavity cancer were much lower among females than males, they similarly declined from highs during the time period 1980–1984. The decline was more rapid in black females, resulting in lower rates among black than white females during 1985–2004. Small declines were also observed for API, AI/AN, and Hispanic females during recent years. Pharynx cancer rates among black men peaked in 1985–1989 at 11.0/100,000 and then declined 39.5% to 6.7 in 2000–2004. From 1980–1984 to 2000–2004, rates declined 44% among black women, from 2.7 to 1.5, and 31% among white women, from 1.6 to 1.1. Rates among white men decreased much less rapidly, and rates among the other ethnic groups all declined between 1995–1999 and 2000–2004. In contrast to the trends for cancers of the oral cavity and pharynx, the greatest decline in larynx cancer rates occurred among white men (a 36% decrease) from 9.4 in 1980–1984 to 6.0 in 2000–2004. Larynx cancer rates peaked during the late 1980s among black males and females and among white females; rates declined in recent years among virtually all gender and race/ethnic groups.

Differences in the temporal incidence patterns for HPV-related and -unrelated cancers of the oral cavity and pharynx were most pronounced among white males (Fig. 3). In contrast to the relatively stable oral cavity and pharynx cancer rates shown in Fig. 2, rates for HPV-related cancer among white men increased 47% from 3.4 in 1975–1979 to 5.0 in 2000–2004, rates of HPV-unrelated cancer peaked at 6.6 in 1980–1984 and then declined 32% to 4.5 in 2000–2004, and rates for

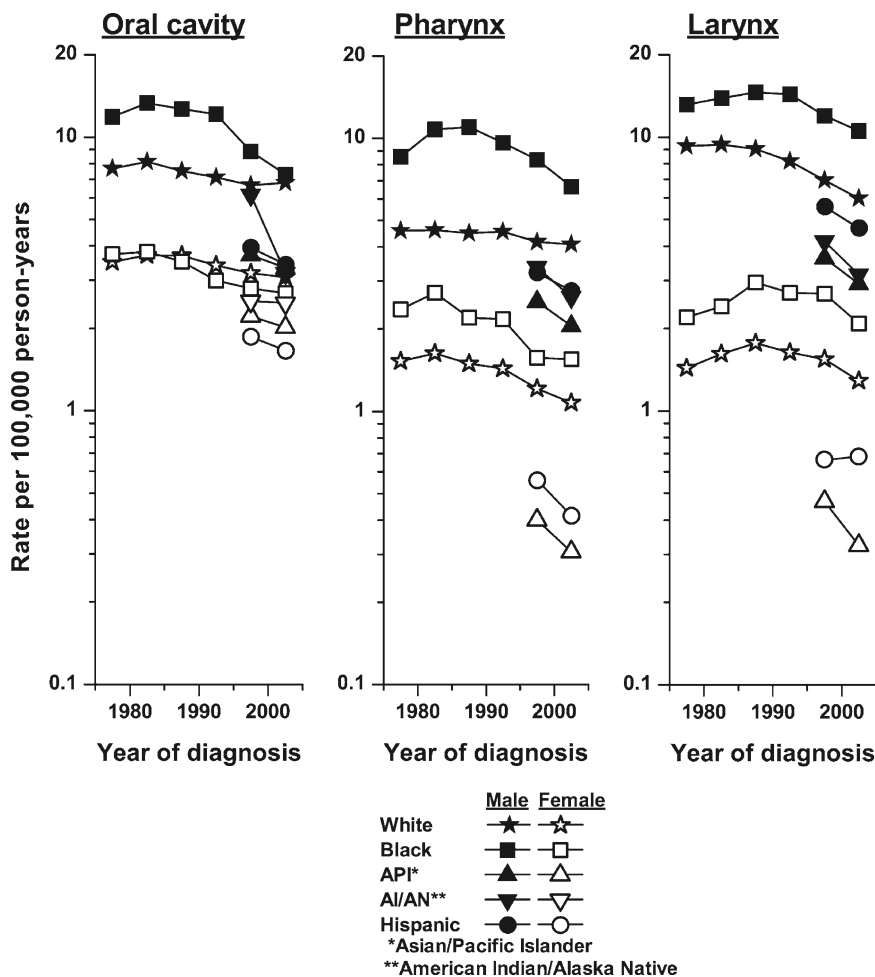


Fig. 2 Temporal trends in oral cavity, pharynx, and larynx squamous cell carcinoma incidence by sex during 1975–1979 to 2000–2004 among whites and blacks in SEER 9 and during 1995–1999 to 2000–2004 among Asian/Pacific Islanders and Hispanics in SEER 12 and among American Indian/Alaska Natives in SEER 13 (rates age-adjusted using 2000 U.S. population standard; excludes lip, salivary gland, and nasopharynx cancers)

cancers with unknown HPV role decreased 44% from 2.5 to 1.4. Among black men, rates for HPV-related cancer peaked at 8.8 in 1985–1989 and then declined 26% to 6.5 in 2000–2004; rates for HPV-unrelated and HPV role unknown declined even more rapidly (52% and 55%, respectively), from highs of 10.1 and 6.0 in 1980–1984 to lows of 4.8 and 2.7 in 2000–2004. Among both white and black females, all rates decreased following highs in the early 1980s, but the rate of decline was greater for black females. Rates of HPV-unrelated cancers were

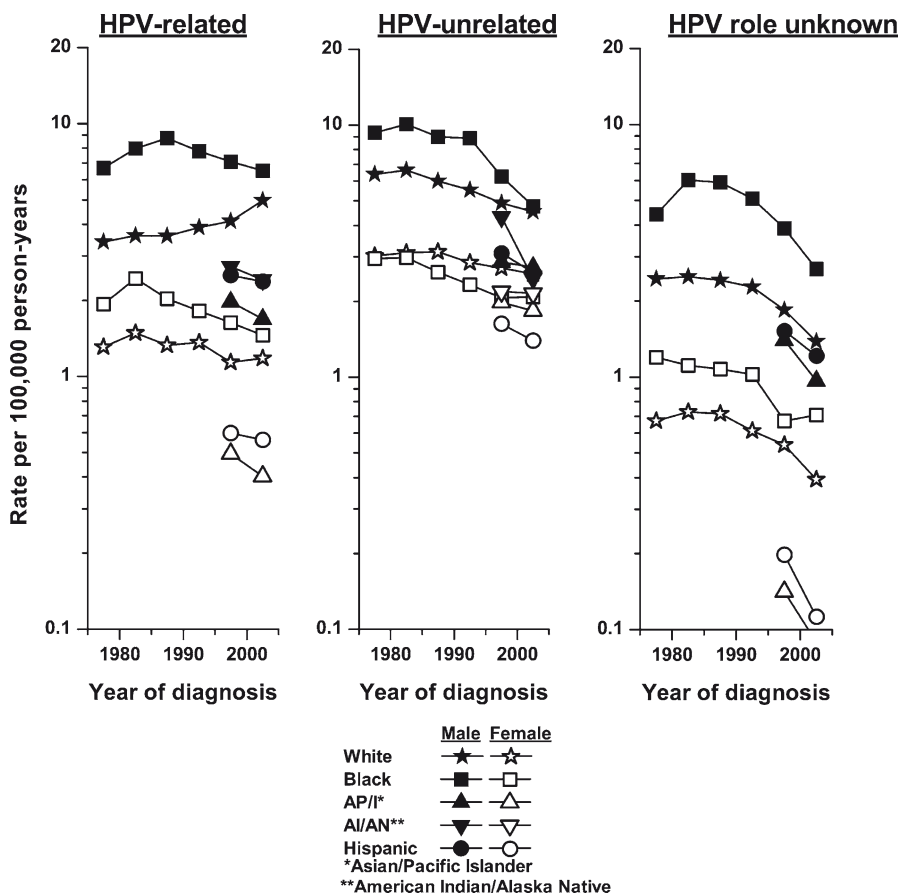


Fig. 3 Temporal trends in oral cavity and pharynx squamous cell carcinoma incidence by sex according to HPV-relationship during 1975–1979 to 2000–2004 among whites and blacks in SEER 9 and during 1995–1999 to 2000–2004 among Asian/Pacific Islanders and Hispanics in SEER 12 and among American Indian/Alaska Natives in SEER 13 (rates age-adjusted using 2000 U.S. population standard; excludes lip, salivary gland, and nasopharynx cancers)

higher in white than black females, whereas rates of HPV-related and HPV role unknown cancers were higher in black females. Rates generally decreased among API, AI/AN, and Hispanic males and females between 1995–1999 and 2000–2004. Thus, HPV-related cancer rates rose notably among white males while declining in recent years among all other race/ethnic/sex groups. HPV-unrelated cancer rates decreased among all groups, more rapidly among blacks than whites. In fact, the black/white HPV-unrelated cancer rate ratio declined from 1.5 in 1975–1979 to 1.1 in 2000–2004 among men, and from 1.0 in 1975–1979 to 0.8 in 2000–2004 among women.

Mortality

Time Trends

National mortality rates are available for the time period 1950–1954 to 2000–2004 for nonwhites and whites, 1970–1974 to 2000–2004 for blacks, and 1995–1999 to 2000–2004 for APIs, AI/ANs, and Hispanics by site and sex (Fig. 4). Rates specifically for blacks have been higher than for all nonwhite populations combined, with the differences increasing over time as the Asian population, with lower rates, grew. Rates for all three cancers among nonwhite and black males and females rose notably before peaking during the 1980s, earlier for oral cavity and pharynx cancers than for larynx cancers, and they have declined 30–60% since then. Rates for all three cancers among white males, which had been higher than those among nonwhites during the 1950s, declined steadily over the last 55 years – about 56% for oral cavity cancer, 36% for pharynx cancer, and 32% for larynx cancer. In contrast, rates among white females rose modestly until peaking in the early 1970s for oral cancer, the late 1970s for pharynx cancer, and the early 1990s for larynx cancer, and declining thereafter. Mortality rates among the other three racial/ethnic groups declined during the recent decade for larynx and oral cancers among all except API females, whereas they rose for pharynx cancer among all except Hispanic males.

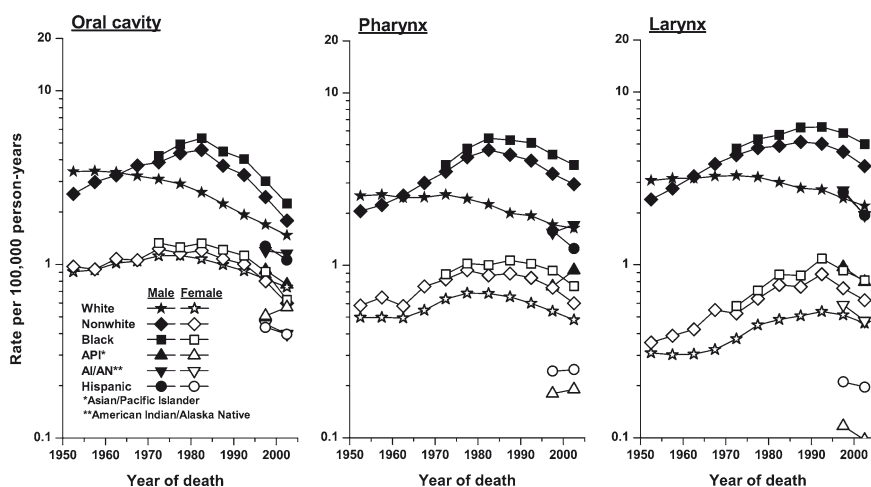


Fig. 4 Temporal trends in oral cavity, pharynx, and larynx cancer mortality by sex during 1950–1954 to 2000–2004 among whites and nonwhites, during 1970–1974 to 2000–2004 among blacks, and during 1995–1999 to 2000–2004 among Asian/Pacific Islanders, American Indian/Alaska Natives, and Hispanics (rates age-adjusted using 2000 U.S. population standard; excludes lip, salivary gland, and nasopharynx cancers)

Geographic Variation

Maps showing age-adjusted mortality rates by state economic area for white men and women during the 25-year period 1980–2004 are presented in Fig. 5a and b, respectively. This is the first time that maps for cancers of the oral cavity and pharynx have been presented separately. Oral cavity cancer rates were high along the East coast among white males and in the Southeast among white females. Rates for females also were elevated in areas of the Northeast, in Nevada, and along the Pacific coast. Rates were low across the Central, Plains, and Rocky Mountain states in both sexes. The clustering of excess mortality among white females in the Southeast was even more prominent during 1950–1969 [9] and was attributed to snuff dipping among women in the rural South [10]. Although the prevalence of snuff dipping has declined in recent decades [11], patches of elevated oral cancer rates still remain in parts of the Carolinas, Georgia, and Florida. Rates of pharynx cancer among white males were elevated across broad stretches of the Southeast, particularly along the East coast and across the Gulf coast into Texas. Rates among females tended to cluster along both the Northern and Southern Atlantic coasts and most of the Pacific coast. Rates were relatively low in the Rocky Mountain and Plains states, more so among males than females. Larynx cancer rates among white men and, to a lesser extent, white women were elevated in scattered areas of the eastern third of the country and in southern Louisiana, but they tended to be low in central and western regions. The clustering of high rates across the eastern part of the country was more pronounced in 1980–2004 than in the period 1950–1979 (data not shown). The geographic patterns of pharynx and larynx cancers are quite similar to those of lung cancer, consistent with the patterns of cigarette smoking, which is a major risk factor [9, 12].

Survival

Recent Patterns and Time Trends

Five-year relative survival rates among patients diagnosed during 1995–2003 with oral cavity, pharynx, or larynx cancer were highest among white males and females – 59% and 57% – and lowest among black males – 39% (Table 2). Within each race/sex group, survival rates were highest for patients with larynx cancer (ranging from 46 to 68%), intermediate among patients with oral cavity cancer (34–58%), and lowest among patients with pharynx cancer (26–51%). For all three sites combined, 5-year relative survival rates improved over the past three decades among whites but not blacks. Rising survival rates were notable among patients with pharynx cancer, except black females; oral cancer patient survival also improved among whites, especially males. In contrast, survival among larynx cancer patients did not improve and even appeared to decline except among white males. When oral cavity and pharynx cancers were divided into presumed HPV-related or not categories,

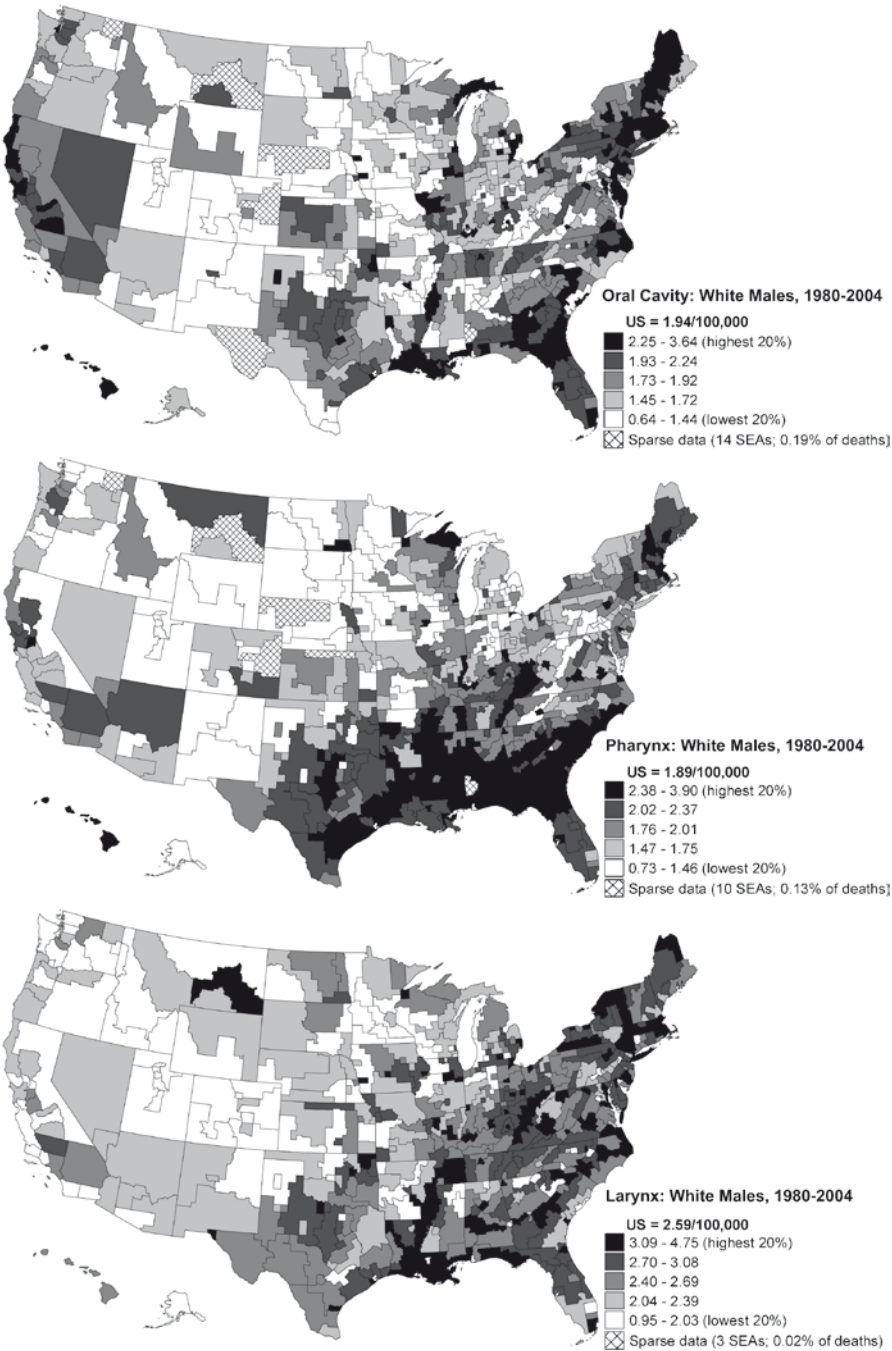


Fig. 5 (a) Oral cavity, pharynx, and larynx cancer mortality rates among white males during 1980–2004 by State Economic Area (SEA) (rates age-adjusted using 2000 U.S. population standard; excludes lip, salivary gland, and nasopharynx cancers)

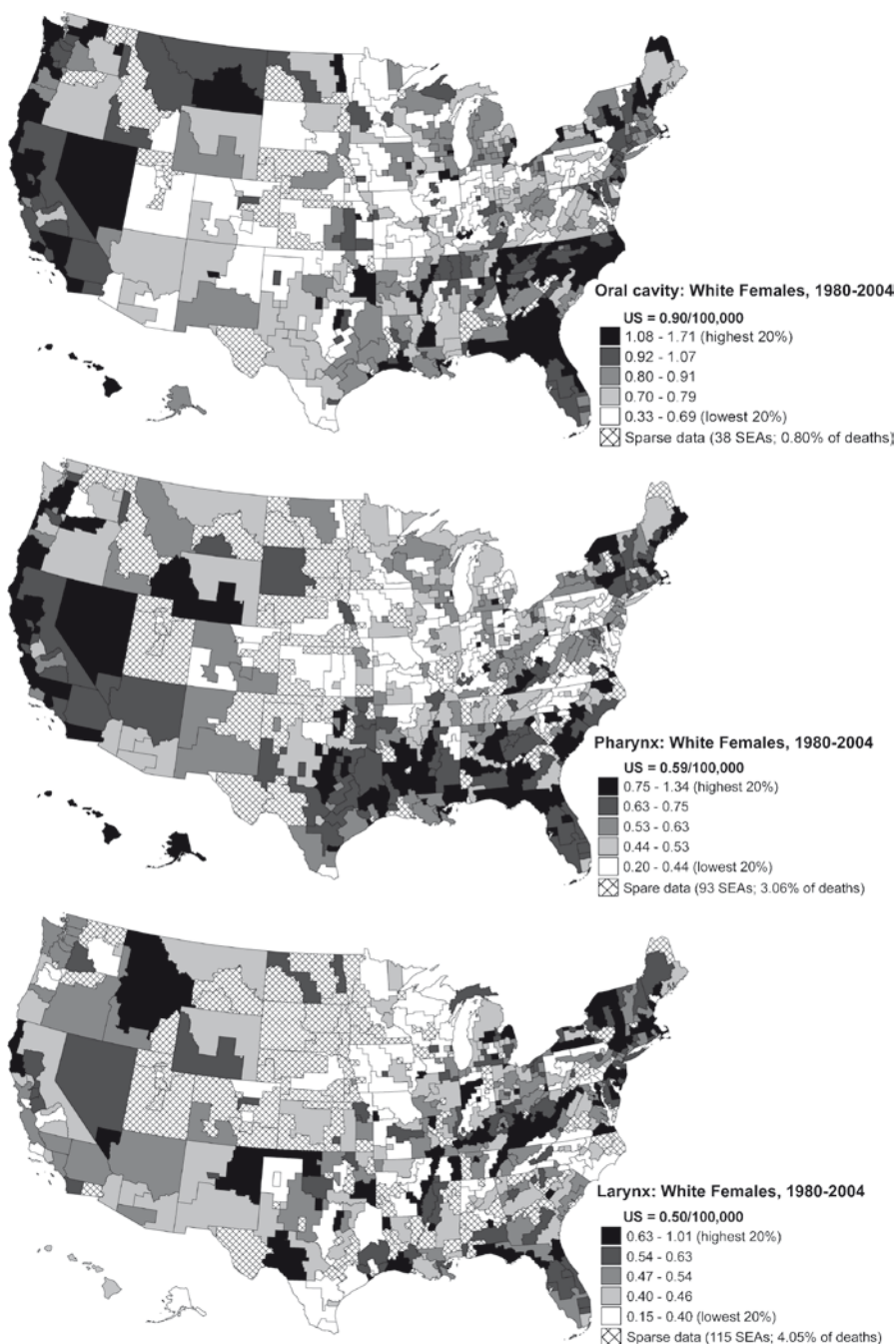


Fig. 5 (continued) (b) Oral cavity, pharynx, and larynx cancer mortality rates among white females during 1980–2004 by State Economic Area (SEA) (rates age-adjusted using 2000 U.S. population standard; excludes lip, salivary gland, and nasopharynx cancers)

Table 2 Five-year relative survival rates among patients diagnosed with squamous cell carcinoma of the oral cavity, pharynx, or larynx during 1975–2003 by race, gender, and time period, SEER 9^a

Site	Year of diagnosis	White males		White females		Black males		Black females	
		Count	Rate	Count	Rate	Count	Rate	Count	Rate
All three sites	1975–1984	14,313	52.9%	5,166	53.3%	2,028	38.0%	587	42.8%
	1985–1994	13,930	55.3%	5,394	55.8%	2,404	36.8%	672	41.7%
	1995–2003	11,860	59.2%	4,410	56.5%	1,934	38.7%	615	41.9%
Oral cavity	1975–1984	5,054	46.3%	2,757	55.0%	693	31.8%	255	43.0%
	1985–1994	4,886	50.2%	2,822	58.4%	788	28.9%	248	39.0%
	1995–2003	4,480	56.1%	2,426	58.1%	599	33.8%	242	44.6%
Pharynx	1975–1984	2,974	30.3%	1,210	37.2%	533	17.0%	169	28.8%
	1985–1994	3,000	36.4%	1,176	40.2%	678	22.6%	187	29.9%
	1995–2003	2,904	50.5%	868	45.5%	566	26.2%	139	29.3%
Larynx	1975–1984	6,285	68.9%	1,199	65.6%	802	57.9%	163	56.8%
	1985–1994	6,044	69.1%	1,396	63.7%	938	54.5%	237	54.0%
	1995–2003	4,476	68.1%	1,116	61.8%	769	52.0%	234	46.4%
Oral cavity and pharynx									
HPV-related	1975–1984	2,283	34.8%	1,048	40.4%	411	18.1%	153	29.0%
	1985–1994	2,533	43.5%	1,050	46.0%	547	25.0%	152	31.9%
	1995–2003	3,219	59.3%	880	55.8%	518	32.1%	143	36.5%
HPV-unrelated/ unknown	1975–1984	5,745	42.6%	2,919	52.8%	815	29.1%	271	41.8%
	1985–1994	5,353	45.7%	2,948	55.5%	919	26.5%	283	36.8%
	1995–2003	4,165	49.8%	2,414	54.1%	647	28.4%	238	40.5%

^aExcludes lip, salivary gland, and nasopharynx cancers; includes follow-up through 2004

survival rates improved markedly among patients with HPV-related cancers for all four race/sex groups. During the most recent time period, survival rates were higher among patients with HPV-related than HPV-unrelated/unknown status cancers, except among black females.

Stage-Specific Patterns

Stage of disease at diagnosis has a dramatic effect on subsequent survival among all patients with HN cancer (Table 3). Among patients diagnosed with oral cavity cancer during 1995–2003, 5-year relative survival rates ranged from 57 to 74% for localized disease to 28–51% for regional disease and 25–38% for distant-stage disease. The corresponding ranges for patients with pharynx cancer were 46–64% for localized, 29–53% for regional, and 10–25% for distant-stage disease; and for patients with larynx cancer, they were 61–86%, 40–50%, and 20–29%, respectively. The largest numbers of patients were diagnosed with regional stage disease for all three cancers among all four race/gender groups, except oral cavity cancer among white females and larynx cancer among whites, where the number localized was the largest. The proportion with distant-stage disease was modest for oral cavity and larynx cancers, but for pharynx cancer, the number of patients with distant-stage disease exceeded the number with localized disease for all except white females. Among white males, the stage distribution at diagnosis was less favorable for HPV-related cancers than not; however, the relative survival rates among patients with regional or distant-stage disease were each notably better among HPV-related cases than not. These figures suggest the improvement in overall survival rates that might be achieved by public health measures aimed at increasing early detection through cancer surveillance programs.

Discussion

Both tobacco and alcohol are well established risk factors for HN cancers regardless of the type of alcoholic beverage consumed or form of tobacco used [13, 14]. For most race/sex groups, the declines in HN cancer incidence and mortality parallel the reduction in cigarette smoking prevalence and may also reflect decreases in alcohol consumption, especially the use of hard liquor [15, 16]. The recent declines in incidence rates for these three squamous cell carcinomas (except for oral cavity and pharynx cancers among white males) are remarkably similar to the declines in squamous cell carcinoma of the lung [17] and esophagus [16, 18]. HPV infection has recently been identified as a risk factor for a subset of oral and pharyngeal cancers arising in the oropharynx, tonsil, and base of tongue, which are also characterized by an improved prognosis [4, 14]. The much smaller declines in the incidence of cancers of the oral cavity and pharynx among white men are probably due to the increased incidence of HPV-associated cancers [15]. The increasing incidence of

Table 3 Five-year relative survival rates among patients diagnosed with squamous cell carcinoma of the oral cavity, pharynx, or larynx during 1995–2003 by race, gender, and stage of disease at diagnosis, SEER 9^a

Site	Stage	White males		White females		Black males		Black females	
		Count	Rate	Count	Rate	Count	Rate	Count	Rate
All three sites	Localized	4,228	79.9%	1,742	73.9%	457	64.1%	166	63.1%
	Regional	6,226	51.3%	2,122	48.7%	1,128	33.7%	346	35.5%
	Distant	1,024	26.2%	349	24.6%	285	22.2%	82	25.8%
Oral cavity	Unstaged	382	51.2%	197	41.3%	64	21.3%	21	28.2%
	Localized	1,562	73.5%	1,062	74.4%	106	56.8%	60	69.8%
	Regional	2,362	50.6%	1,049	48.5%	378	27.6%	143	34.3%
Pharynx	Distant	384	25.1%	183	27.3%	90	37.9%	34	30.6%
	Localized	307	63.9%	134	59.0%	53	45.9%	13	47.1%
	Regional	2,140	53.3%	595	47.5%	383	29.0%	97	31.4%
Larynx	Distant	370	24.9%	107	21.1%	107	10.0%	23	17.8%
	Localized	2,359	86.0%	546	76.0%	298	70.0%	93	61.2%
	Regional	1,724	49.8%	478	50.4%	367	45.1%	106	39.7%
Oral cavity and pharynx HPV-related	Distant	270	29.3%	59	20.4%	88	21.3%	25	25.5%
	Localized	332	70.1%	147	65.4%	41	61.9%	17	53.3%
	Regional	2,440	62.2%	604	58.3%	355	34.2%	97	36.0%
HPV-unrelated/unknown	Distant	374	33.0%	97	29.3%	107	17.4%	25	29.5%
	Localized	1,537	72.2%	1,049	73.7%	118	50.8%	56	69.5%
	Regional	2,062	39.8%	1,040	41.9%	406	22.8%	143	31.1%
	Distant	380	16.9%	193	22.9%	90	27.9%	32	22.5%

^aExcludes lip, salivary gland, and nasopharynx cancers; includes follow-up through 2004

these tumors, many with an improved prognosis, may also have contributed to the dramatic improvement in survival seen for white men in the most recent time period, 1995–2003. The decreased survival for patients with larynx cancer has been noted previously and is possibly due to the increase in nonsurgical management (i.e., radiation and chemoradiation) instead of the more invasive laryngectomy [19]. Dietary factors, particularly consumption of fruits and vegetables, have been consistently associated with a reduced risk of HN cancers [13, 14]. Per capita consumption of fresh fruits and vegetables increased 31% and 24%, respectively, from the early 1970s to the late 1990s, which may have contributed to the downward incidence trends observed for these tumors in recent years [16, 18, 20]. Occupational exposures probably play only a minor role in the etiology of HN cancers and are unlikely to explain any of the observed descriptive patterns [13, 14].

The temporal trends and race/sex patterns observed most likely reflect the impact of exposure to tobacco (particularly cigarettes) and alcohol (particularly hard liquor), diet (especially intake of fruits and vegetables), and more recently, HPV (often through oral sex practices [21]). Although it has been suggested that rates of oral cavity and pharynx cancer could be reduced if HPV vaccination were widespread among boys as well as girls [22, 23], it would take many years before such a reduction was evident in the temporal trends. Finding explanations for some anomalous observations, including the decreasing black/white rate ratios for HPV-unrelated cancers among females, may help clarify the roles of known and as yet unidentified risk factors.

Acknowledgments This research was supported by the Intramural Research Program of the Division of Cancer Epidemiology and Genetics, order should by Intramural Research Program of the DCEG, NCI, NIH, National Cancer Institute, National Institutes of Health. The authors thank Mr. John Lahey and Mr. David Castenson, Information Management Services, Inc., Rockville, MD and Mr. David Check, Biostatistics Branch, DCEG, NCI, Rockville, MD for data tabulation and preparation of figures.

References

1. Jemal A, Siegel R, Ward E, Hao Y, Xu J, Thun MJ (2009) Cancer Statistics, 2009. *CA Cancer J Clin* 54:225–249
2. Ries LAG, Melbert D, Krapcho M, Mariotto A et al (eds) (2007) SEER cancer statistics review, 1975–2004. National Cancer Institute, Bethesda, MD. http://seer.cancer.gov/csr/1975_2004/, based on November 2006 SEER data submission, posted to the SEER web site, 2007
3. World Health Organization (2000) International classification of diseases for oncology, 3rd edn. World Health Organization, Geneva (Switzerland)
4. Chaturvedi AK, Engels EA, Anderson WF, Gillison ML (2008) Incidence trends for human papillomavirus-related and unrelated oral squamous cell carcinomas in the United States. *J Clin Oncol* 26:612–619
5. SEER*Stat (2007) Surveillance Research Program, National Cancer Institute SEER*Stat software (www.seer.cancer.gov/seerstat) version 6.3.6. Accessed 25 Feb 2008

6. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 9 Regs Limited-Use, Nov 2006 Sub (1973–2004) – Linked To County Attributes – Total U.S., 1969–2004 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2007, based on the November 2006 submission
7. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 13 Regs Limited-Use, Nov 2006 Sub (1973–2004) – Linked To County Attributes – Total U.S., 1969–2004 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2007, based on the November 2006 submission
8. Devesa SS, Donaldson J, Fears T (1995) Graphical presentation of trends in rates. *Am J Epidemiol* 141:300–304
9. Devesa SS, Grauman DJ, Blot WJ, Pennello GA, Hoover RN, Fraumeni JF Jr (eds) (1999) Atlas of cancer mortality in the United States 1950–94. National Institutes of Health, National Cancer Institute, NIH Publication No. 99-4564
10. Winn DM, Blot WJ, Shy CM, Pickle LW, Toledo A, Fraumeni JF Jr (1981) Snuff dipping and oral cancer among women in the southern United States. *N Engl J Med* 304:745–749
11. Giovino GA, Schooley MW, Zhu BP et al (1994) Surveillance for selected tobacco-use behaviors–United States, 1900–1994. *MMWR CDC Surveill Summ* 43:1–43
12. Devesa SS, Grauman DJ, Blot WJ, Fraumeni JF Jr (1999) Cancer surveillance series: changing geographic patterns of lung cancer mortality in the United States, 1950 through 1994. *J Natl Cancer Inst* 91:1040–1050
13. Olshan AF (2006) Cancer of the larynx. In: Schottenfeld D, Fraumeni JF Jr (eds) *Cancer epidemiology and prevention*, 3rd edn. New York, Oxford
14. Mayne ST, Morse DE, Winn DM (2006) Cancers of the oral cavity and pharynx. In: Schottenfeld D, Fraumeni JF Jr (eds) *Cancer epidemiology and prevention*, 3rd edn. New York, Oxford
15. Sturgis EM, Cinciripini PM (2007) Trends in head and neck cancer incidence in relation to smoking prevalence – an emerging epidemic of human papillomavirus-associated cancers? *Cancer* 110:1429–1435
16. Brown LM, Devesa SS (2002) Epidemiologic trends in esophageal and gastric cancer in the United States. *Surg Oncol Clin N Am* 11:235–256
17. Devesa SS, Bray FB, Vizcaino AP, Parkin DM (2005) International lung cancer trends by histologic type: male:female differences diminishing and adenocarcinoma rates rising. *Int J Cancer* 117:294–299
18. Brown LM, Devesa SS, Chow W-H (2008) Incidence of adenocarcinoma of the esophagus among white Americans by sex, stage, and age. *J Natl Cancer Inst* 100:1184–1187
19. Hoffman HT, Porter K, Karnell LH (2006) Laryngeal cancer in the United States: changes in demographics, patterns of care, and survival. *Laryngoscope* 116(Suppl. 111):1–13
20. Putnam JJ, Allshouse JE (1999) Food consumption, prices, and expenditures, 1970–97. In: *Statistical Bulletin – Economic Research Service (USA)* no. 965, USDA, Economic Research Service, Washington, DC
21. Gillison ML (2007) Current topics in the epidemiology of oral cavity and oropharyngeal cancers. *Head Neck* 29:779–792
22. D’Souza G, Kreimer AR, Viscidi R et al (2007) Case-control study of human papillomavirus and oropharyngeal cancer. *N Engl J Med* 356:1944–1956
23. Clossmann JJ (2007) The human papilloma virus, the vaccines, and oral and oropharyngeal squamous cell carcinoma: what every dentist should know. *Gen Dent* 55:252–254

Epidemiology, Pathogenesis, and Prevention of Head
and Neck Cancer

Olshan, A.F. (Ed.)

2010, XI, 207 p., Hardcover

ISBN: 978-1-4419-1471-2