

Received: 2014.05.17

Accepted: 2014.09.01

Published: 2014.12.04

# Pediatric Head and Neck Tumors: An Intra-Demographic Analysis Using the SEER\* Database

Authors' Contribution:  
Study Design A  
Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
Literature Search F  
Funds Collection G

ABCDEF 1,2 **Alper Cesmebasi**  
ABCDEF 2,3 **Abigail Gabriel**  
ABCDEF 2 **Daniel Niku**  
ABCDEF 2 **Karolina Bukala**  
ABCDEF 2 **Joseph Donnelly**  
ABCDEF 2 **Paul J. Fields**  
ABCDEF 2,4 **R. Shane Tubbs**  
ABCDEF 2,5 **Marios Loukas**

1 Departments of Neurologic and Orthopedic Surgery, Mayo Clinic, Rochester, MN, U.S.A.  
2 Department of Anatomical Sciences, St. George's University, Grenada, West Indies  
3 Department of Internal Medicine, Harlem Hospital, New York, NY, U.S.A.  
4 Department of Pediatric Neurosurgery, Children's Hospital, Birmingham, AL U.S.A.  
5 Department of Anatomy, Varmia and Mazuria Medical School, Olsztyn, Poland

**Corresponding Author:** Marios Loukas, e-mail: mloukas@sgu.edu  
**Source of support:** Departmental sources

**Background:** The aim of this study was to determine the most frequently presenting tumors exclusive to the head and neck within the pediatric population, and to identify racial disparities within the existing incidence rates.





**Material/Methods:** The population-based Surveillance, Epidemiology, and End Results (SEER) registry was utilized to identify the frequency and incidence rates of various tumors found exclusively in the head and neck, diagnosed between 1973 and 2008 in pediatric patients. The tumor categories were based on those defined by the US Department of Health and Human Services National Cancer Institute (NCI). Proportional comparisons were applied to evaluate the intra-demographic incidence rate differences.

**Results:** Among the 11 categories defined, the 5 most prevalent head and neck cancers within the pediatric population were salivary gland tumors (n=319); followed by nasopharyngeal neoplasms (n=311); tumors of the nose, nasal cavity and middle ear (n=208); gum and other mouth tumors (n=134); and glossal tumors (n=61). Proportional comparisons between racial frequency rates indicated that salivary gland tumors were greatest among white pediatric patients (n=246, CI=0.8 to 14.1%,  $p<.05$ ). Nasopharyngeal cancers were highest among blacks (CI=-26.8 to -12.1%) and other races (CI=-23.6 to -3.4%) relative to the white population.

**Conclusions:** Salivary gland tumors were the most commonly seen head and neck tumors overall among pediatric patients between 1973 and 2008. Incidence rate differences between white, black, and other racial background pediatric patients revealed that overall, head and neck tumors are most prevalent among pediatric patients within the white ethnic population, while nasopharyngeal tumors showed a strong prevalence in blacks and other ethnic populations.

**MeSH Keywords:** Cohort Studies • Head and Neck Neoplasms • Salivary Gland Neoplasms

**Full-text PDF:** <http://www.medscimonit.com/abstract/index/idArt/891052>

 2572  1  3  29



## Background

Cancer, as the second-leading cause of death in the pediatric population of the United States, accounts for a significant number of deaths among the pediatric population [1]. Among several different cancer categories identified in this population, head and neck tumors account for approximately 5% of all reported pediatric tumors. Although the majority of head and neck masses in children are inflammatory, etiologies may include congenital or neoplastic lesions. Gurney et al. reported that the overall prevalence of head and neck tumors within the infant and adolescent populations is significantly low. However, the incidence of neoplasms is greatest during the first year of life [2]. Albright et al. states that over the last 3 decades, the incidence rates of cancer in the pediatric population have increased with certain malignancies, such as lymphomas and rhabdomyosarcomas [3]. However, due to lack of information, whether this trend can be applied to head and neck cancers remains unclear.

There are differing opinions among authors and clinicians as to what exactly constitutes head and neck tumors [3,4]. Prior investigations of these tumors were either limited by a criterion that was not anatomically or histologically exclusive to the head and neck or were focused primarily on a particular race and specific tumor site affected [5–11]. For instance, neuroblastomas and lymphomas are the most common head and neck malignancies among infants, children, and adolescents. However, neuroblastomas are typically considered neuroendocrine neoplasms not specific to one location, while lymphomas are neoplasms of the immune system [12,13]. In essence, there are many overlapping definitions, and neither of the cancer types is exclusive to the head and neck. Additionally, rhabdomyosarcoma, a soft-tissue sarcoma with one-third of the cases seen in the head and neck region, may be histologically identified as skeletal muscle tumors that can originate anywhere [14]. Therefore, rhabdomyosarcoma cannot be categorized exclusively as a cancer of the head and neck [15].

Investigation of head and neck tumors should be devoid of such discrepancy and variation; clarity in the definition and the incidence rates of these cancers is important and should be established. As such, the National Institutes of Health (NIH) has categorized head and neck tumors as squamous cell carcinomas that affect the mouth, nose, and throat [1]. Typically, these are sub-categorized as 1) the oral cavity, including the lips, front two-thirds of the tongue, gingiva, buccal mucosa, floor of tongue and hard palate; 2) the salivary glands, paranasal, and nasal cavities, 3) the pharynx; and 4) the larynx. These selections were contrived to manage the variations among head and neck cancer classification studies. Thus, through the utilization of the established NIH categories, the objective of this study was to identify most common pediatric head and

neck tumors, using the SEER database, and to compare prevalence rates intra-demographically according to race and age.

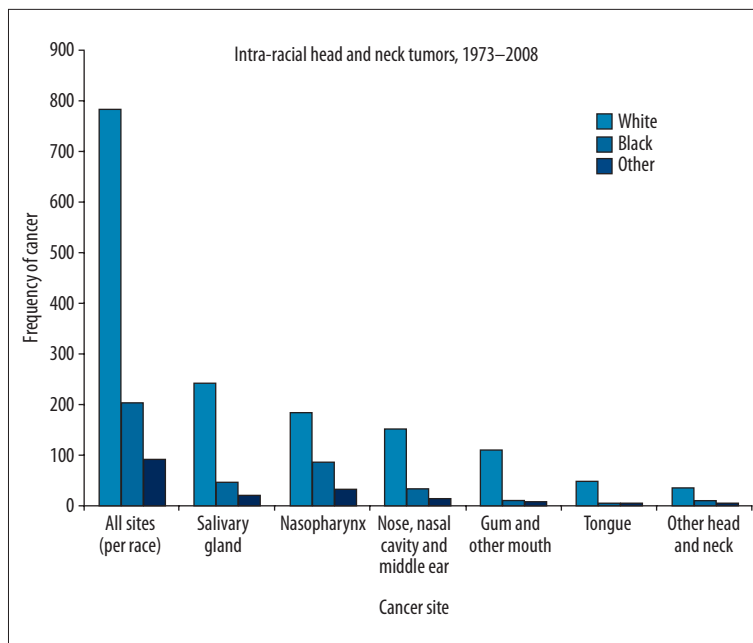
## Material and Methods

The National Cancer Institute compiles cancer related data made publicly available as the Surveillance, Epidemiology, and End Results (SEER) cancer registry. Following the November 2010 submissions, SEER 17 covered 26% of the United States population, which included 17 registered areas. This study utilized the SEER database to extrapolate pediatric patient information regarding head and neck cancers. Patients included in this study were infants (within the first year of life), children (1–12 years old), and adolescents (13–19 years old) diagnosed with head and neck cancers in the United States from 1973 to 2008. Only 11 categories (lip, tongue, salivary gland, floor of mouth, gum and other mouth, nasopharynx, tonsil, oropharynx, hypopharynx, nose, nasal cavity and middle ear, and larynx), distinguished as head and neck cancers according to the classification proposed by the US Department of Health and Human Services National Cancer Institute (NCI), were included in this study. Tumors arising from the CNS, thyroid, lymphoid, vasculature, scalp, skin, bones, and skeletal muscles of the head or neck are not part of the NCI criteria, and therefore were not included in this study.

After running a frequency session using the SEER 17 database, the 5 most common tumors were identified from the 11 inclusion categories. Five specific tumor types were shown to account for 95% of reported cases of head and neck tumors: salivary glands; nasopharynx; nose, nasal cavity, and middle ear; gum and other mouth; and tongue tumors. Since the remaining 6 tumor types combined accounted for only a small percentage, they were grouped under the heading *Other Head and Neck Tumors*. The data were grouped into twelve 3-year periods of diagnosis: 1973–1975, 1976–1978, 1979–1981, 1982–1984, 1985–1987, 1988–1990, 1991–1993, 1994–1996, 1997–1999, 2000–2002, 2003–2005, and 2006–2008. Covariates of year of diagnosis, site and morphology, age, and race were used. Race was identified as white, black, or other (American Indian/AK Native, Asian/Pacific Islander).

Incidence rates were then calculated as cases per 100 000 population using the SEER 9 Registry (1973–2008), and age-adjusted incidence rates were calculated using the 2000 US census data for 0–19 year olds and graphed over 3-year periods from 1973 to 2008. These rates were further analyzed by race individually for each of the 6 tumor groups, and collectively for all head and neck tumors.

Comparative proportional analysis of incidence rates was done using chi-square test to identify variability of head and neck



**Figure 1.** Interracial Pediatric Head and Neck Tumors, 1973–2008. White pediatric patients were affected by head and neck tumors more frequently from 1973–2008. Frequency sessions from the National Cancer Institutes Surveillance, Epidemiology, and End Reports (SEER) were utilized to identify these cases among whites, blacks, and other (American Indian/AK Native, Asian/Pacific Islander).

neoplasms within the individual races, as well as between the 3 race groups. Confidence intervals were calculated to provide the percentile range of differences between White-Black, White-Other, and Black-Other ethnic groups. Comparisons were graphed to identify which racial group(s) had a greater propensity for a particular neoplasm using GraphPad Prism Version 5.04 (GraphPad Software Inc, 2012, La Jolla, CA, [www.graphpad.com/prism](http://www.graphpad.com/prism)).

## Results

From 1973 to 2008, the SEER registry reported 1088 head and neck tumor cases among pediatric patients 0–19 years of age. Of these cases, salivary gland ( $n=319$ ), nasopharyngeal ( $n=311$ ), nose, nasal, and middle ear ( $n=208$ ), gum and other mouth ( $n=134$ ), and tongue ( $n=61$ ) neoplasms had the 5 highest prevalence rates of the 11 categories analyzed (Figure 1).

An intra-demographic analysis of prevalence of each head and neck cancer showed that patients within the white racial group overall had the greatest number of cases per 100 000 population. Although white patients had the highest prevalence for most of the tumor categories, the proportion of nasopharyngeal cancer was highest among blacks and others, and hence showed a higher prevalence when compared to white patients (Table 1).

Comparative proportional analysis showed differences between whites/blacks for salivary gland tumors, between whites/blacks and whites/others for nasopharyngeal tumors, and between whites/blacks for gum and other mouth tumors. Among 319

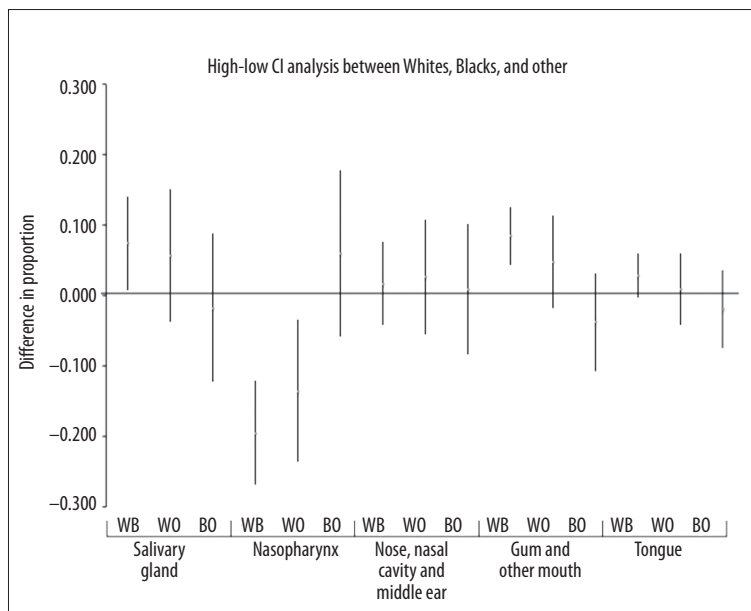
patients with salivary gland tumors, 246 (31.20%) reported salivary gland cases among whites ( $CI=28.0-34.4\%$ ), 49 (23.80%) cases among blacks, and 24 cases (25.5%) among others. When a comparison analysis of frequency proportions was performed, there was a trend toward intra-demographic distribution, specifically between whites and blacks ( $CI\ 0.8-14.1\%$ ) (Figure 2). Comparison of incidence rates further elucidates the significant difference between whites and blacks ( $CI\ 0.6-17.1\%$ ).

Comparatively, blacks had a higher proportion of nasopharyngeal cases, with 89 (43.2%) when compared to whites 187 (23.7%) and others 35 (37.2%). This suggests that black and other populations have a greater propensity toward developing nasopharyngeal tumors. Proportion analysis of nasopharyngeal cases shows that the incidence rate reiterates the previous data showing a significant proportional difference between whites/blacks and white/others. Blacks ( $\hat{p}=0.406$ ) have a greater proportion of nasopharyngeal tumors over time relative to whites ( $\hat{p}=0.239$ ) and other ( $\hat{p}=0.397$ ). A comparison of incidence rates between Whites-Blacks (WB), Whites-Others (WO), and Blacks-Others (BO) demonstrates that there is likely (95% CI,  $P<.05$ ) a greater incidence rate for nasopharyngeal tumors among blacks ( $CI=-25.8$  to  $-7.6\%$ ) and others ( $CI=-28.8$  to  $-2.8\%$ ) when compared to whites (Figure 2). There is also a greater incidence of gum and other mouth tumors among whites when compared to blacks ( $CI=4.4-12.6\%$ ). The remaining comparisons had thresholds that crossed the zero line, indicating a likelihood of no difference in frequency or incidence rates. Overall, the incidence of all 11 categorized head and neck tumors from 1973 to 2008 across 3-year intervals showed a positive correlation (Figure 3). A regression analysis between year of diagnosis and incidence was  $R^2=0.3014$ .

**Table 1.** Intra-demographic breakdown of prevalence for head and neck tumors among pediatric (ages 0–19 years) populations from 1973 to 2008. Of these stratifications, 95% of the reported site cases were found in salivary glands, nasopharynx, nose, nasal cavity and middle ear, gum and other mouth, and tongue.

Characteristic	Prevalence of pediatric head and neck tumors, 1973–2008			
	00–19 years			
	All races	White	Black	Other
Salivary Gland	319	246	49	24
Nasopharynx	311	187	89	35
Nose, nasal cavity and middle ear	208	155	37	16
Gum and other mouth	134	113	12	9
Tongue	61	49	7	5
Larynx	16	14	2	0
Lip	13	9	3	1
Floor of mouth	9	5	3	1
Oropharynx	7	3	2	2
Tonsil	6	4	2	0
Hypopharynx	4	3	0	1
<b>Total</b>	<b>1088</b>	<b>788</b>	<b>206</b>	<b>94</b>

Other – American Indian/AK native, Asian/Pacific Islander.

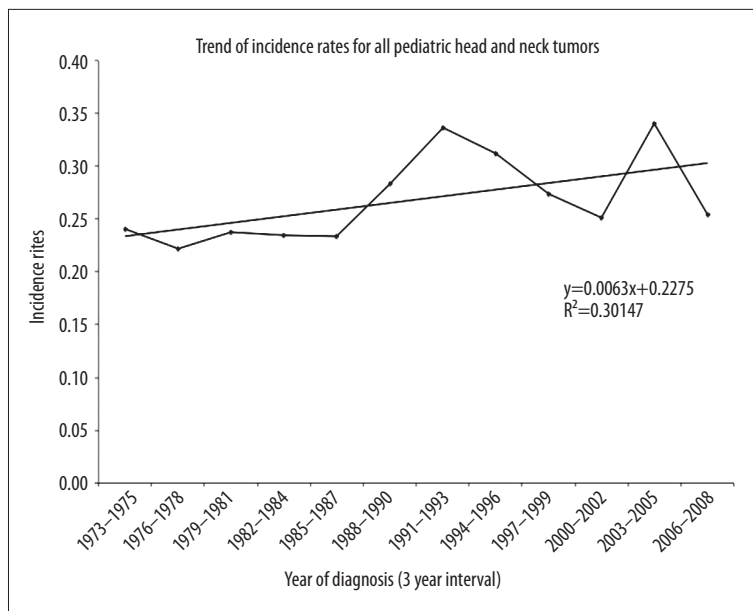


**Figure 2.** Frequency proportion comparisons between ethnicities for the top 5 head and neck tumors (WB – White-Black, WO – White-Other, BO – Black-Other). We used 95% confidence intervals (CI) to express the potential range that these cancers will occur per race.

## Discussion

Head and neck tumors account for 5% of all childhood cancers [16,17]. According to Albright et al., the increase in the incidence of head and neck tumors among children younger than 15 years has exceeded the overall rise in all cancers for this specific age group [3]. Epidemiological studies have

shown that inheritable types of cancer form only a minor portion of childhood tumors. The increase in incidence suggests that environmental causes may play a significant role [3]. However, previous studies had inconsistencies in defining pediatric head and neck tumors [3], particularly with the inclusion and exclusion criteria used. Some of these studies have included histological categories not exclusive to the head and



**Figure 3.** Trend of incidence rates for all pediatric head and neck tumors from 1973 to 2008. There was a positive correlation with a regression value of  $R^2=0.301$ .

neck, such as lymphomas as a part of the head and neck tumors, which in turn increased the overall incidence rates of these tumors. Additional analysis of categorization has yielded concerns about head and neck criteria, particularly when analyzing trends in incidence rates [18]. Thus, it was imperative to adopt standard criteria in defining head and neck tumors, such as that offered by the National Cancer Institute (NCI), for this study [1].

From 1973 to 2008, the inclusion population ( $n=788$ ) had an overall increase in incident rates, showing a positive correlation ( $R^2=0.3014$ ) in head and neck cancers among infants, children, and adolescents. Additionally, from 1985 to 1993, there was a rising incidence in the reported cancers among this age group, followed by a decrease into the early 2000s. It remains unclear why this fluctuation in incidence rates occurred. Although slight increases and decreases are seen, the overall correlation is positive, and Linabery et al. suggest that factors such as improved genetic screening, increasingly sensitive diagnostic modalities, and increased reporting among races accounts for the overall increase in reported incidence [19]. Bleyer also states that during the last 25 years, the incidence of cancer in this age range has increased faster, while the increase of cancer survival rates has been significantly slower than in younger or older patients [20].

From the data in this study, the 5 highest incidence rates and relative frequencies of squamous cell carcinomas of the head and neck region were found in: (1) salivary glands, (2) nasopharynx, (3) nose, nasal cavity, and middle ear, (4) gum and other mouth, and (5) tongue. Of the 1088 reported SEER17 cases, approximately 95% were in these top 5 categories. Further investigation of intra-demographic incidence rates of the top 5

tumor sites indicated white patients had the greatest overall prevalence of the above-mentioned tumors. Unique intra-demographic differences among salivary gland, nasopharyngeal, and gum and other mouth tumors were also significant [21–24].

The data from this study shows that salivary gland tumors had the greatest incidence of all reported cancers within the identified categories. Sultan et al. presented information pertaining to salivary gland tumors and identified the peak incidence at 15 years of age [14]. Most of these salivary gland tumors were noted to arise from the parotid gland [25]. Other studies indicated that tumors, in comparison to inflammatory diseases affecting the salivary gland, are quite rare, with an annual incidence of 1 per 100 000 cases [23]. It is vital to consider that although salivary gland tumors are relatively rare, the incidence within the white pediatric population is significantly higher than for any other racial group. When analyzing the incidence rate for each specific tumor type intra-demographically, comparisons (Figure 3) that included zero in their ranges, indicating a  $P$  value greater than 0.05, showed no statistical difference between races. However, if the range excluded zero, a statistical difference was noted. Such a difference was identified and showed that (Figure 3) whites ( $CI=0.8-14.1\%$ ) have more salivary gland tumors relative to blacks and other races.

The analysis of nasopharyngeal tumors showed a greater propensity among blacks and other races relative to the white population. Presenting at a median of 13 years of age, nasopharyngeal tumors have been historically exhibited at incidences 30 times greater in Southeastern Asia in comparison to the incidence found in the United States [26,27]. The opposing rate values seen in this study were not a surprise, as it had been noted in prior studies. These studies showed black pediatric



patients in the United States, when compared to Asian pediatric patients, have an incidence rate ratio to white patients for nasopharyngeal cancers of 1.69 per 100 000 versus 0.95, respectively [26]. The most likely explanation for these opposing statistics is environmental factors. However, further investigation is necessary to identify the cause of this discrepancy.

Finally, there were 134 reported cases of gum and other mouth tumors from 1973 to 2008. Despite the small population size, comparisons of white and black (CI=4.4% to 12.6%) showed a CI not including zero, thus indicating that whites have a greater tendency to present with gum and other mouth tumors. The remaining tumor site comparisons either expressed no significant differences between the groups, or the population size was too small to make a comparison.

The limitations of the present study include the narrow scope of the search and lack of information on the contributors of incidence change. While these limitations exist, it was the focus of the study to determine the incidence rates of tumors exclusive to the head and neck. It is also critical to note that although the incidence rates have been identified along with intra-demographic comparisons, there are still many unknowns regarding the etiology of pediatric head and neck tumors, thus the inability to note the contributors of incidence changes. Etiological presumptions may be made and include, among all races, environmental and exogenous exposures, such as cigarette smoking, excessive alcohol consumption, viral susceptibility, congenital abnormalities, and genetic dysregulation [22,26-28].

## References:

1. National Cancer Institute. Fact Sheet: Head and Neck Cancers. [cited 2011 November 9, 2011]; Available from: <http://cancer.gov/cancertopics/factsheet/Sites-Types/head-and-neck> - 3.
2. Gurney JG, Ross JA, Wall DA et al: Infant cancer in the U.S.: histology-specific incidence and trends, 1973 to 1992. *J Pediatr Hematol Oncol*, 2007; 19: 428-32
3. Albright JT, Topham AK, Reilly JS: Pediatric head and neck malignancies - US incidence and trends over 2 decades. *Arch Otolaryngol Head Neck Surg*, 2002; 128: 655-59
4. Das K, Jain S, Chichra A et al: Non-hematological tumors of head and neck region in the pediatric age group in a tertiary care cancer center. *Pediatr Surg Int*, 2011; 27: 919-23
5. Torsiglieri AJ, Tom LW, Ross AJ III et al: Pediatric neck masses: guidelines for evaluation. *Int J Pediatr Otorhinolaryngol*, 1998; 6: 199-210
6. Biswas D, Saha S, Bera SP: Relative distribution of the tumours of ear, nose and throat in the paediatric patients. *Int J Pediatr Otorhinolaryngol*, 2007; 71: 801-5
7. Jaffe BF: Pediatric head and neck tumors: A study of 178 cases. *Laryngoscope*, 1973; 83: 1644-51
8. Cunningham MJ, Myers EN, Bluestone CD: Malignant tumors of the head and neck in children: A 20-year review. *Int J Pediatr Otorhinolaryngol*, 1987; 13: 279-92
9. Zevallos JP, Jain KS, Roberts D et al: Sinonasal malignancies in children: A 10-year, single-institutional review. *Laryngoscope*, 2011; 121: 2001-3
10. Vazquez E, Castellote A, Mayolas N et al: Congenital tumours involving the head, neck and central nervous system. *Pediatr Radiol*, 2009; 39: 1158-72
11. Sengupta S, Pal R: Clinicopathological correlates of pediatric head and neck cancer. *J Cancer Res Ther*, 2009; 5: 181-85
12. Li J, Thompson TD, Miller JW et al: Cancer incidence among children and adolescents in the United States, 2001-2003. *Pediatrics*, 2008; 121: e1470-77
13. Birch JM, Blair V: The epidemiology of infant cancers. *Br J Cancer Suppl*, 1992; 18: S2-S4
14. Sultan I, Rodriguez-Galindo C, Al-Sharabati S et al: Salivary gland carcinomas in children and adolescents: A population-based study, with comparison to adult cases. *Head Neck*, 2011; 33: 1476-81
15. McCarville MB, Spunt SL, Pappo AS: Rhabdomyosarcoma in pediatric patients: The good, the bad, and the unusual. *Am J Roentgenol*, 2001; 176: 1563-69
16. Dickson PV, Davidoff AM: Malignant neoplasms of the head and neck. *Semin Pediatr Surg*, 2006; 15: 92-98
17. Sengupta S, Pal R: Clinicopathological correlates of pediatric head and neck cancer. *J Cancer Res Ther*, 2009; 5: 181-85
18. Smith MA, Seibel NL, Altekruse SF et al: Outcomes for children and adolescents with cancer: challenges for the twenty-first century. *J Clin Oncol*, 2010; 28: 2625-34
19. Linabery AM, Ross JA: Trends in childhood cancer incidence in the U.S. (1992-2004). *Cancer*, 2008; 112: 416-32

## Conclusions

Between 1973 and 2008, the 5 most common head and neck cancers among infants, children and adolescents were (in order of prevalence): salivary gland; nasopharyngeal; nose, nasal cavity, and middle ear; gum and other mouth; and glossal tumors. Relative to intra-demographic comparisons, whites have the greatest overall incidence of these conditions, particularly salivary gland, gum, and other mouth tumors. However, blacks and other racial populations have a greater proportion of nasopharyngeal tumors when compared to the white population. While the scope of the current study did not include data on staging of disease, survival rates, or treatment, it is critical that future projects provide up-to-date analyses of pediatric head and neck tumors. It also remains to be seen if future researchers will adopt the criteria set forth by the National Cancer Institute, and whether previous classifications will be re-adopted under those new categories. If the classification criteria continue to overlap and consensus is not reached between studies, then the identification of head and neck tumors among pediatric populations will remain relatively inconsistent. It is necessary for clinicians and researchers to utilize a system that is consistent and yields statistical information that is clinically representative and accurate of all pediatric head and neck tumors. More importantly, the rise in head and neck tumors among pediatric patients between 1973 and 2008 is alarming, and the identification of risk factors to prevent future increase is important. Among data obtained in this study, racial differences in incidence rates recognize ethnic background as a significant risk factor for pediatric head and neck tumors; a significant finding that may contribute to future research.

20. Bleyer WA: Cancer in older adolescents and young adults: Epidemiology, diagnosis, treatment, survival, and importance of clinical trials. *Med Pediatr Oncol*, 2002; 38: 1–10
21. Lee K, Strauss M: Head and neck cancer in blacks. *J Natl Med Assoc*, 1994; 86: 530–34
22. Slotman GJ, Swaminathan AP, Rush BF: Head and neck cancer in a young age group: high incidence in black patients. *Head Neck Surg*, 1983; 5: 293–98
23. Ellies M, Laskawi R: Diseases of the salivary glands in infants and adolescents. *Head Face Med*, 2010; 6: 1
24. Jeyakumar A, Brickman TM, Doerr T: Review of nasopharyngeal carcinoma. *Ear Nose Throat J*, 2006; 85: 168–70
25. Bradley P, McClelland L, Mehta D: Paediatric salivary gland epithelial neoplasm. *ORL J Otorhinolaryngol Relate Spec*, 2007; 69: 137–45
26. Richey LM, Olshan AF, George J et al: Incidence and survival rates for young blacks with nasopharyngeal carcinoma in the United States. *Arch Otolaryngol Head Neck Surg*, 2006; 132: 1035–40
27. Ayan I, Kaytan E, Ayan N: Childhood nasopharyngeal carcinoma: from biology to treatment. *Lancet Oncol*, 2003; 4: 13–21
28. Stiller CA: Epidemiology and genetics of childhood cancer. *Oncogene*, 2004; 23: 6429–44
29. Surveillance, Epidemiology, and End Results (SEER) Program ([www.seer.cancer.gov](http://www.seer.cancer.gov)) SEER\*Stat Database: Incidence – SEER 9 Regs Research Data, Nov 2010 Sub (1973-2008) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969–2009 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2011, based on the November 2010 submission