Cancers of the Thyroid: Overview and Statistics in the United States and Oklahoma

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Abstract

Recent studies have shown an apparent increase in thyroid cancer in the United States. Whether is due to an actual increase or increased screening is disputed. We analyzed thyroid cancer incidence and mortality across age and racial groups in Oklahoma (using data from the Oklahoma Central Cancer Registry) against Surveillance, Epidemiology, and End Results (SEER) program national data – using SEER*Stat software for mortality. In the US and Oklahoma, females had a higher AAIR compared to males, but it was lower in Oklahoma than in the US (Females: US 15.5 per 100,000, OK 10.9 per 100,000; Males: US 5.4 per 100,000, OK 3.8 per 100,000). Overall, five-year relative survival was lower, yet still high, for Oklahoma than in the US (92.1% v. 97.1%). Survival by stage was lower in Oklahoma compared to the United States for localized (97.8% v. 99.8%), regional (92.0% v. 97.0%), and distant (36.6% v. 55.3%) stage cancers.

INTRODUCTION

Recent data have shown an apparent increase in the incidence of thyroid cancer in the United States.[1] The annual percent change (for both men and women) from 1980 – 1997 was a 2.4% increase per year, but from 1997 to 2009, this increased to 6.6% per year.[1] There is disagreement on the exact cause of this increase – particularly whether it is an accurate reflection on thyroid cancer cases actually increasing, or rather due to increased screening.[2] Literature reviews suggests controversy, with evidence that could be interpreted to support either idea. Studies have shown that increased detection of the preclinical manifestations of thyroid cancer are a key contribution factor of the increased incidence rate.[2] However, others have reported evidence of a true increase in incidence, that cannot be fully explained simply by an increase in diagnosis – and thus suggesting that the increase could be due to lifestyle and environmental factors, as well.[3]

The carcinomas of the thyroid are demarcated and named for the primary cell type within the thyroid that is affected.[4] Typically, they are all referred to as thyroid cancer. Thyroid cancer is a relatively rare cancer, but it is the most common cancer of the endocrine system.[5] The four subtypes of this cancer are papillary carcinoma, follicular carcinoma, medullary carcinoma, and anaplastic carcinoma.[6] Papillary carcinoma, which comprises approximately

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80 – 85% of all thyroid cancers, has the highest prognosis, with ten-year survival being more than 95%.[6] Although frequently diagnosed at early stages, papillary carcinoma can spread to the cervical lymph nodes, and is highly associated with exposure to ionizing radiation.[6] Follicular carcinoma comprises ten percent of thyroid cancer cases, and is one of the few types among all cancer types to spread through hematogenous routes instead of lymph pathways. Medullary carcinoma (comprising five percent of thyroid cancer cases) is associated with hereditary mutations of the RET oncogene. Lastly, anaplastic (or undifferentiated) carcinomas – which have the poorest prognosis – comprise less than five percent of all thyroid cancer cases. Generally, anaplastic carcinomas afflict the elderly far more than those of younger ages. These carcinomas are typically fatal within a few years.[6]

The American Cancer Society suggests routine screening as part of a periodic physical exam and health counseling to include thyroid cancer screening for men and women 20 years and older.[10] The USPSTF is currently reviewing and updating their thyroid cancer screening recommendations.[11] However, in 1996, their published recommendations for asymptomatic thyroid cancer screening using palpation or ultrasound was a grade D, meaning they recommend against the use of these screenings. Asymptomatic screening for those with childhood head and neck irradiation was a grade C, meaning it is suggested that these screenings are selectively offered based on patient preference and provider judgment.[11]

The purpose of this study was to analyze thyroid cancer incidence and mortality across age and racial groups in Oklahoma against Surveillance, Epidemiology, and End Results (SEER) program data.

METHODS

To determine incidence rates of thyroid cancer in Oklahoma, we used existing data from the Oklahoma Central Cancer Registry (OCCR), which includes data on all cancer cases diagnosed in Oklahoma residents from 1997–2012. The OCCR is a participant in the National Program of Cancer Registries and follows all guidelines of the North American Association of Central Cancer Registries. To obtain data on incidence of thyroid cancer in the US, we used the Surveillance, Epidemiology, and End Results (SEER) program data from 1997–2012. We restricted this analysis to those diagnosed with thyroid cancer using the SEER site recodes for thyroid cancer, which included International Classification of Diseases of Oncology, Third Edition/World Health Organization (ICDO-3/WHO) 2008 site codes of C739, excluding histology codes of 9050-9055, 9140, 9590-9992 (lymphomas, Kaposi sarcoma, and mesothelioma).[12] We used SAS v. 9.4 (Cary, NC) to calculate age-adjusted incidence rates (AAIR) per 100,000 by the direct method using the 2000 standard population.[13] To calculate AAIR for the US, we used SEER*Stat software (v. 8.2.1) using the SEER 13 region data, which included more detailed information on race and Hispanic ethnicity.[14] We compared AAIR and 95% confidence intervals over time from 1997–2012, by demographic groups of sex, and race/ethnicity.[14] We classified race/ethnicity as white non-Hispanic (NH), African American NH, American Indian/Alaska Native (AI/AN) NH, Asian/Pacific Islander NH, and Hispanic. To reduce misclassification of the AI/AN population, we linked the cancer records with the Indian Health Service (IHS) records. For this study, AI/ANs who either reported their primary race as AI/AN or who linked with an

IHS record regardless of the primary race selected, were reclassified as AI/AN. Age-specific incidence rates were calculated in five-year age groups, combining those under 20 years of age and 75 years and older for stability and confidentiality reasons. We also evaluated stage at diagnosis using the SEER Summary Stage 2000 for those diagnosed between 1998 and 2003 and the derived SEER Summary Stage 2000 for those diagnosed between 2004 and 2012 for Oklahoma and the Summary Stage 2000 for the SEER data from 1998–2012. We excluded cancers reported on a death certificate only or at autopsy for analysis of staging.

To evaluate survival from thyroid cancer, we used data from the OCCR and SEER using SEER*Stat software. We calculated five-year relative survival by age, sex, race, stage, and year of diagnosis for Oklahoma and SEER data using the expected survival life tables provided by SEER.[16] By comparing the observed and expected survival in the population, relative survival allows for the estimation of excess deaths due to cancer in the population without the need for underlying cause of death.[15] Expected survival was only available for the racial groups of white, African American, and other (AI/NA and Asians/Pacific Islanders). Hispanic ethnicity was also not available. We grouped year of diagnosis into 1997–2000, 2001–2003, and 2004–2008 for stability purposes. We used the same SEER Summary Stage classification as in the incidence estimates. The OCCR conducts routine follow-up on all cancer cases and links with the Oklahoma Mortality Data, the Social Security Death Index, and the National Death Index to determine mortality. Follow-up was conducted through November 1, 2014, thus we limited our analysis of survival from 1997–2008 to allow for more complete five-year survival for all cases of thyroid cancer.

This study was approved by the Institutional Review Boards of the University of Oklahoma Health Sciences Center and the Oklahoma State Department of Health.

RESULTS

Incidence

Thyroid cancer is the 8th leading cause of cancer in the United States with an estimated 62,450 new cases in 2015 accounting for 3.8% of cancers.[1] In 2015, there will be an estimated 1,950 deaths due to thyroid cancer which accounts for 0.3% of all cancer mortality.[1] In the US, the age-adjusted incidence rate of thyroid cancer from 1997–2012 was 10.5 per 100,000 (95% CI: 10.4, 10.6 per 100,000) compared to 7.4 per 100,000 in Oklahoma (95% CI: 7.2, 7.6) (Table 1). In both the US and in Oklahoma, females had a higher AAIR compared to males, but the estimate was lower in Oklahoma than in the US (Females: US 15.5 per 100,000, OK 10.9 per 100,000; Males: US 5.4 per 100,000, OK 3.8 per 100,000). When evaluating race/ethnicity, the AAIR was higher in the US for all race/ethnicity groups except AI/AN NH, which were similar at 8.2 per 100,000 in the US (95% CI: 7.5, 9.0) and 8.7 in Oklahoma (95% CI: 7.8, 9.6). Among Asian/Pacific Islander NHs, the incidence in the US was 10.9 per 100,000 (95% CI: 9.1, 9.5) compared to 3.5 per 100,000 (95% CI: 1.9, 5.1) in Oklahoma, though the Oklahoma estimate was imprecise. Age-specific incidence increased with increasing age until 75 years, when it decreased to 14.0 per 100,000 in the US and 11.7 per 100,000 in Oklahoma. Again, the age-specific incidence was higher in the US and Oklahoma for all age groups. Regarding stage, 66.5% were diagnosed at local stage, 18.6% at regional stage, and 4.9% at distant stage (10.1%

unknown) in Oklahoma, compared to the US with 64.0% at local stage, 25.7% at regional stage, and 4.7% at distant stage (2.0% unknown). In our analysis by year of diagnosis, the AAIR increased in both the US and Oklahoma, though remained lower in Oklahoma than the US throughout the period (Figure 1). In Oklahoma, the AAIR increased from 3.9 per 100,000 in 1997 to 12.3 per 100,000 in 2012. In the US, the AAIR increased from 6.7 per 100,000 in 1997 to 14.2 per 100,000 in 2012.

Survival

Overall, five-year relative survival was lower, yet still high, for Oklahoma than in the US (92.1% v. 97.1%) (Table 2). In general, survival was higher for females than males, but was lower for both males (84.2% v. 94.4%) and females (94.7% v. 98.0%) in Oklahoma compared to the US, respectively. Regarding race, survival was highest in the unknown and white population in the US, followed by African Americans and those in the Other category. In Oklahoma, there were no significant differences by race; however, African Americans had a lower estimate compared to other racial groups. When comparing Oklahoma and the US, white (92.2% v. 97.4%) and African Americans (85.9% v. 95.3%) in Oklahoma had lower survival than those in the US, respectively, but the confidence intervals overlapped for Other and unknown racial groups. While survival generally decreased with increasing age, based on confidence intervals, Oklahomans from ages 40–44 years, 50–54 years, 55–59 years, and 75 years and older at cancer diagnosis had poorer five-year relative survival compared to these same age groups in SEER, but the confidence intervals overlapped for the remaining age groups. Over time, survival increased slightly in the US from 95.9% in 1997–2000 to 97.6% in 2004–2008. While there was no significant increase observed in Oklahoma, the survival estimates increased from 90.4% in 1997–2000 to 93.3% in 2004–2008. When comparing Oklahoma and the US, survival was lower, yet still above 90%, for each category of year of diagnosis in Oklahoma. Survival by stage was also lower in Oklahoma for localized (97.8% v. 99.8%), regional (92.0% v. 97.0%), and distant (36.6% v. 55.3%) stage cancers, but followed similar trends.

DISCUSSION

Thyroid cancer is not a particularly common cause of cancer, even with the recent apparent increases in incidence. Historically thyroid cancer survivability has been very high – among the highest of all types of cancer, with the five-year relative rate having been consistently above ninety percent.[1] Currently, that rate is almost ninety-eight percent in the US.[1] Though the incidence continues to rise, there does not appear to be a concurrent effect on survival, as evidence by our data. The relationship between this admittedly minute uptick and the recent increases in incidence have not yet been conclusively demonstrated. The high overall relative survival suggests that the cases being detected are either not clinically important or are being effectively managed with the treatment options currently at hand.

Women in general, across all races, have a higher incidence of thyroid cancer than men.[1] In the United States, whites and Asians/Pacific Islanders have a higher incidence rate of thyroid cancer, with African Americans having a particularly low incidence rate.[1] However, this may not be reflective of actual incidence rates, and may be more reflective of increased detection

(medical surveillance bias), in turn stemming from increased access to healthcare – which itself is correlated with increased wealth.[17]

The clinical stage at which thyroid cancer is first detected can have quite a pronounced effect on survivability. As is the case with most all cancer scenarios, an earlier diagnosis yields higher rates of survival. Metastasis to regional lymph nodes, which can make the cancer more likely to spread to other parts of the body,[6] does not decrease survivability considerably. However, metastasis to more distant sites does dramatically reduce survivability (from nearly one hundred percent to almost half at fifty-four percent).[1]

All the characteristic-specific rates in Oklahoma are lower than the corresponding rates in the United States. This can be because of a truly lower incidence across all groups, or from a lower rate of diagnosis across all groups – or even a combination of both. As mentioned previously, there is conflicting evidence and marked controversy about the recent increase in thyroid cancer incidence.[2,3] That same uncertainty can be present in Oklahoma as well. This disparity presents an intriguing avenue for future study. Furthermore, future studies should consider evaluating specific subtypes of thyroid cancer by race/ethnicity to understand whether disparities in incidence and survival exist. Oklahoma's survivability figures were less than those of the United States in virtually every characteristic. This may be due to Oklahoma's relative poverty compared to the United States as a whole.[18] As established above, socioeconomic status (SES) is correlated with relative increases in diagnosis and incidence of thyroid cancer, but SES is also correlated with increased use of medical care.[17,19] Poverty may be associated with a relative decreases in diagnosis and incidence of thyroid cancer.[20] Following diagnosis, the various treatment options for thyroid cancer all require significant medical care by specialists.[21–23] Since specialist medical care is disproportionately available to and used by the affluent,[17] an economically disadvantaged population will have less access to such care. This will have a negative effect on survivability.[21–23] Thus, a state like Oklahoma, with generally lower SES, can be expected to have both lower incidence rates and lower survivability for thyroid cancer.

Although thyroid cancer is not an extensive cause of cancer mortality, the increasing incidence rate makes it of great interest. The exact cause of increase has not yet been explained and is probably mutlifactorial. Prevention guidelines have not been put forth as evidence-based strategies have not yet been published. Further research is needed to identify the factors contributing to the increasing incidence of thyroid cancer, both in the United States and Oklahoma. Further, the deviation from national data for thyroid cancer incidence across racial groups is also a possible avenue for further study. The reasons for Oklahoma's lower incidence rates and survivability are also as yet inconclusive, and certainly merit further study. This information will assist in establishing solid prevention recommendations which may decrease the incidence of thyroid cancers in the future. Additionally, it can guide the recommendations for diagnosis treatment so as not to over treat subclinical cancers.

Acknowledgments

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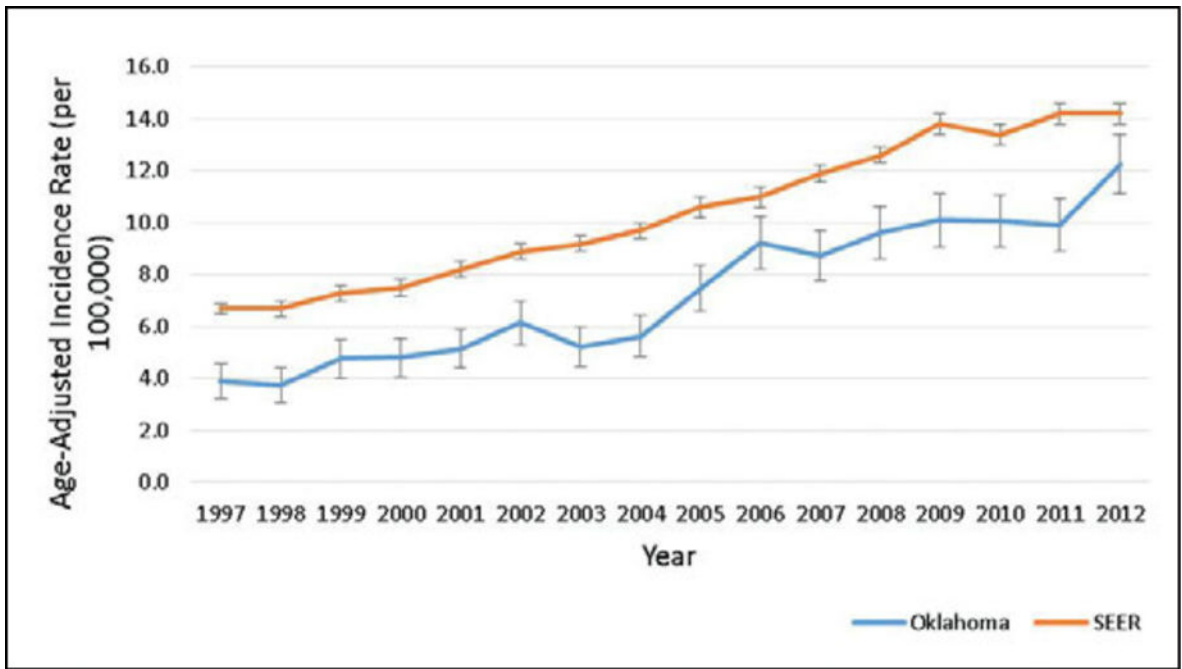
Figure 1.
Age-adjusted incidence rates per 100,000 and 95% confidence intervals by year for the US and Oklahoma, 1997–2012.

Table 1

Oklahoma and United States incidence (per 100,000) of thyroid cancer by gender, age, and race (1997 – 2012)[21]

Characteristic	Oklahoma Incidence % (95% CI)	United States Incidence % (95% CI)
Overall	7.4 (7.2, 7.6)	10.5 (10.4, 10.6)
Sex		
Male	3.8 (3.6, 4.1)	5.4 (5.3, 5.4)
Female	10.9 (10.5, 11.3)	15.5 (15.4, 15.6)
Race/Ethnicity		
White NH	7.6 (7.3, 7.9)	11.5 (11.4, 11.6)
African American NH	4.9 (4.2, 5.6)	6.6 (6.4, 6.8)
American Indian/Alaska Native NH	8.7 (7.8, 9.6)	8.2 (7.5, 9.0)
Asian or Pacific Islander NH	3.5 (1.9, 5.1)	10.9 (10.7, 11.2)
Hispanic	7.2 (5.9, 8.5)	9.3 (9.1, 9.5)
Age at Diagnosis		
0–19 years	0.4 (0.3, 0.5)	0.7 (0.7, 0.7)
20–24 years	3.8 (3.2, 4.4)	4.9 (4.7, 5.1)
25–29 years	6.3 (5.5, 7.1)	8.4 (8.1, 8.7)
30–34 years	8.5 (7.5, 9.4)	11.3 (11.0, 11.6)
35–39 years	9.6 (8.6, 10.6)	13.9 (13.6, 14.3)
40–44 years	9.8 (8.9, 10.8)	15.4 (15.0, 15.7)
45–49 years	11.6 (10.6, 12.7)	16.9 (16.6, 17.3)
50–54 years	12.7 (11.6, 13.9)	18.8 (18.3, 19.2)
55–59 years	12.8 (11.5, 14.0)	19.2 (18.7, 19.6)
60–64 years	13.1 (11.8, 14.5)	19.4 (18.9, 19.9)
65–69 years	15.4 (13.7, 17.0)	20.8 (20.2, 21.5)
70–74 years	14.3 (12.6, 16.0)	19.0 (18.3, 19.6)
75+ years	11.7 (10.6, 12.8)	14.0 (13.6, 14.4)

Table 2

Five-year relative survival for thyroid cancer in Oklahoma and the US by selected characteristics, 1997–2008.[16]

Characteristic	Oklahoma 5-Year Relative Survival % (95% CI)	SEER 5-Year Relative Survival % (95% CI)
Overall	92.1 (90.8, 93.5)	97.1 (96.9, 97.3)
Sex		
Male	84.2 (80.7, 87.6)	94.4 (93.8, 94.9)
Female	94.7 (93.4, 96.1)	98.0 (97.8, 98.2)
Race/Ethnicity		
White	92.2 (90.8, 93.7)	97.4 (97.2, 97.6)
African American	85.9 (77.7, 94.1)	95.3 (94.2, 96.1)
Other[a]	93.5 (90.2, 96.9)	95.9 (95.2, 96.4)
Unknown	96.2 (86.0, 100.0)	99.8 (94.8, 100.0)
Age at Diagnosis		
0–19 years	97.9 (93.4, 100.0)	98.7 (97.9, 99.2)
20–24 years	99.3 (97.5, 100.0)	99.5 (99.1, 99.8)
25–29 years	99.2 (97.5, 100.0)	99.7 (99.3, 99.9)
30–34 years	99.5 (98.1, 100.0)	99.7 (99.4, 99.8)
35–39 years	98.9 (97.2, 100.0)	99.5 (99.2, 99.7)
40–44 years	95.9 (93.2, 98.6)	99.4 (99.1, 99.6)
45–49 years	97.2 (94.8, 99.6)	98.9 (98.5, 99.2)
50–54 years	93.9 (90.7, 97.2)	98.3 (97.8, 98.7)
55–59 years	90.5 (86.0, 94.9)	96.8 (96.2, 97.4)
60–64 years	89.1 (83.7, 94.5)	95.4 (94.4, 96.2)
65–69 years	90.8 (85.3, 96.4)	94.7 (93.5, 95.8)
70–74 years	82.9 (74.9, 90.8)	89.8 (87.9, 91.5)
75+ years	69.2 (60.1, 78.3)	81.9 (79.9, 83.8)
Year of Diagnosis		
1997–2000	90.4 (87.4, 93.5)	95.9 (95.4, 96.4)
2001–2003	90.6 (87.7, 93.6)	96.9 (96.4, 97.2)
2004–2008	93.3 (91.6, 95.0)	97.6 (97.4, 97.9)
Stage		
Localized	97.8 (96.6, 99.1)	99.8 (99.7, 99.9)
Regional	92.0 (88.9, 95.1)	97.0 (96.6, 97.4)
Distant	36.6 (27.7, 45.6)	55.3 (53.4, 57.1)
Unknown/unstaged	84.5 (79.5, 89.5)	88.3 (86.3, 90.1)