Trend in Thyroid Cancer Incidence among Rhode Island Adults, 1995–2016

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In a previous column, the Rhode Island Department of Health (RIDOH) documented a rapid and steady increase of cancers of the thyroid among Rhode Island women and men between 1995 and 2016.[1] In 1995, thyroid cancer accounted for 1% of primary malignant cancers diagnosed within adults.[2] During the ensuing two decades, thyroid cancer diagnoses more than tripled, accounting for 3% of 2016 adult cancer cases.[2] For this report, we further assessed demographic and tumor characteristics and incidence changes between 1995 and 2016 to better understand patterns and underlying reasons for the rising rates of thyroid cancer in Rhode Island.

METHODS

Since October of 1986, the Rhode Island Cancer Registry (RICR) has collected cancer case reports. Since 1995, this effort has been supported in part by the Centers for Disease Control and Prevention National Program of Cancer Registries (CDC NPCR), a federally-mandated program that supports state-based cancer surveillance and sets standards for quality, complete and timely cancer case collection and data management.

Using the RICR data, we extracted invasive malignant thyroid cancers (ICD-O-3 site/behavior: C739/3) diagnosed in adults aged 20 years and older, from January 1, 1995 through December 31, 2016. Thyroid cancer incidence, disease progression and prognosis differ by age, histologic type, size and stage at diagnosis. This study assessed histologic subtypes and coded "papillary," "follicular," "medullary," "anaplastic," and "other," using ICD-O-3 (**Table 1**). Tumor sizes were grouped into two cohorts, "<2 cm" and "≥2 cm." Stage at cancer diagnosis was classified as "localized," "regional," or "distant," using the "Derived Summary Stage 2000" system (https://training.seer.cancer.gov/ss2k/2000/). Since the coding systems have been used to record size and stage of cancers since 2004, size and stage summaries were limited to cancers diagnosed between 2004 and 2016, the most current full year of data available in the RICR.

Table 1. Histologic Subtypes of Thyroid Cancer

Subtype	Histology code (ICD-O-3)*
Papillary	8050, 8052, 8060, 8340, 8341, 8342, 8343, 8344, 8350
Follicular	8290, 8330, 8331, 8332, 8335
Medullary	8345, 8346, 8347, 8510
Anaplastic	8012, 8020, 8021, 8030, 8031

* ICD-O-3: International Classification of Disease for Oncology, 3th edition

SAS v9.4® statistical analytic software (SAS Institute Inc., Cary, NC) was used to count frequencies and calculate age-adjusted rates per 100,000 residents using the 2000 US standard population (https://seer.cancer.gov/stdpopulations/), by cancer type, diagnosis year, sex and age group (20–54 years and ≥55 years). Incidence rates and rate ratios of two distinct 11-year periods (1995–2005 *vs*. 2006–2016) were estimated, and we evaluated magnitudes of rate differences over the study period. State population estimates for rate denominators were obtained from the National Cancer Institute Surveillance, Epidemiology, and End Results Program (NCI SEER; https://seer.cancer.gov/popdata/download.html). Jointpoint Regression Analysis software v4.6.0.0 (http://surveillance.cancer.gov/jointpoint/) was also used to calculate and assess trends between 1995 and 2016 with statistical significance testing of annual percent change (p-value<0.05).

RESULTS

Thyroid cancer incidence changes by sex

From 1995 to 2016, women's thyroid cancers comprised a majority of the state's diagnosed cases; 2,503 women and 830 men were diagnosed with malignant thyroid cancers in Rhode Island during that period (**Table 2**). Compared to 1995–2005, the rates in 2006–2016 for both sexes doubled (rate ratio for women=2.08; rate ratio for men=1.98, **Table 2**). Women still had far greater incidence rates than men (37.9 compared with 13.1, **Table 2**).

Thyroid cancer by subtype and sex, and incidence changes

Thyroid cancers in Rhode Island are predominantly papillary carcinomas – 89% and 83% of the cases of women and men, respectively (**Table 2**). Papillary cancer was three times more commonly diagnosed among women than men. **Figure 1** demonstrates that nearly all thyroid cancer increases between 1995 and 2016 were attributable to increases in the papillary subtype. From 1995 to 2016, diagnoses of thyroid cancer overall and of the papillary thyroid cancer subtype increased steadily, on nearly identical parallel slopes, by 6% among females and 5% to 5.5% among males each year (**Figure 1**).

Approximately 9% of all thyroid cancers were follicular

Table 2. Malignant thyroid cancer counts and incidence rate changes among Rhode Island adults (ages ≥ 20 years), by sex and cancer subtype, 1995–2016 Rhode Island Cancer Registry

	# (%) of Cases 1995–2016	Rate (95% CI)†		Rate Ratio (b/a) (95% CI)
		1995–2005 (a)	2006–2016 (b)	
Women				
All thyroid	2,503	18.2 (16.9-19.5)	37.9 (36.1-39.8)	2.08 (1.91-2.27)
Papillary	2,226 (89%)	16.3 (15.1-17.5)	34.0 (32.3-35.8)	2.09 (1.91-2.29)
Follicular	200 (8%)	1.3 (1.0-1.6)	3.0 (2.5-3.6)	2.38 (1.74-3.30)
Other*	77 (3%)	0.6 (0.4-0.9)	0.9 (0.6-1.2)	ns
Men				
All thyroid	830	6.6 (5.9-7.5)	13.1 (12.1-14.3)	1.98 (1.71-2.31)
Papillary	688 (83%)	5.3 (4.6-6.1)	11.0 (10.0-12.0)	2.06 (1.74-2.43)
Follicular	84 (10%)	0.8 (0.5-1.1)	1.3 (0.9-1.7)	1.61 (1.01-2.62)
Other*	58 (7%)	0.5 (0.3-0.8)	0.9 (0.6-1.3)	ns

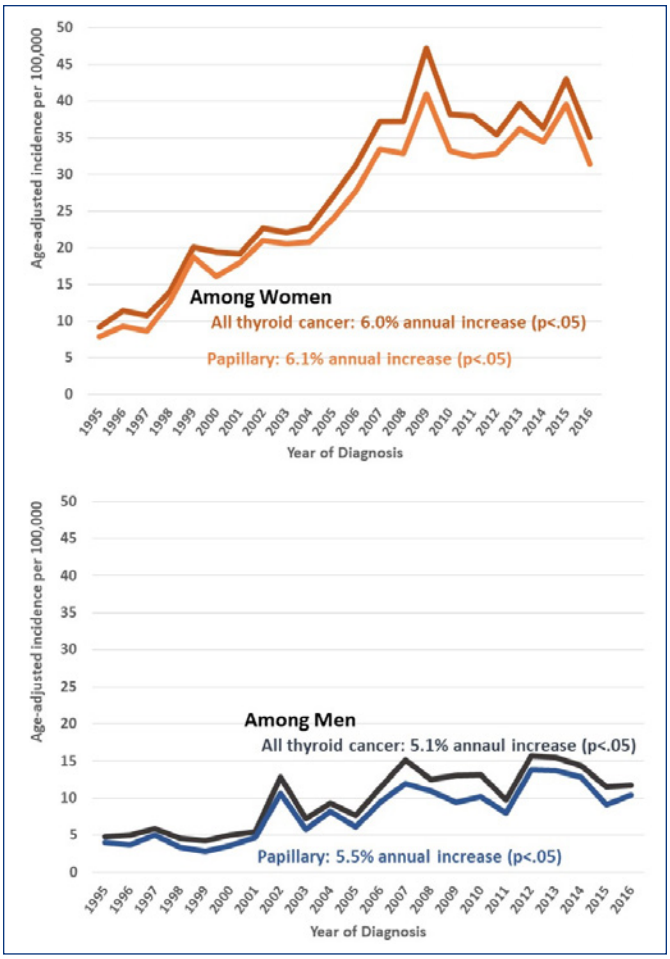
* Medullary, anaplastic and all other subtypes were combined.
† Rates are per 100,000 and age-adjusted to the 2000 US Population Standard.
CI = confidence interval
ns = not a significant difference in rate ratio at p value=.05 level

Table 3. Malignant papillary thyroid cancer counts and incidence rate changes among Rhode Island adults (ages ≥ 20 years) by sex and age group, 1995–2016 Rhode Island Cancer Registry

	# (%) of Cases 1995–2016	Rate (95% CI)†		Rate Ratio (b/a) (95% CI)
		1995–2005 (a)	2006–2016 (b)	
Women (age in years)				
Papillary cancer	2,226	16.3 (15.1-17.5)	34.0 (32.3-35.8)	2.09 (1.91-2.29)
20-54	1,490 (67%)	17.7 (16.3-19.3)	34.9 (32.7-37.2)	1.97 (1.77-2.19)
≥55	736 (33%)	12.9 (11.1-14.9)	31.8 (29.2-34.6)	2.47 (2.08-2.93)
Men (age in years)				
Papillary cancer	688	5.3 (4.6-6.1)	11.0 (10.0-12.0)	2.06 (1.74-2.43)
20-54	384 (56%)	4.9 (4.1-5.8)	9.1 (8.0-10.3)	1.87 (1.51-2.33)
≥55	304 (44%)	6.4 (5.0-8.0)	15.3 (13.4-17.5)	2.39 (1.83-3.15)

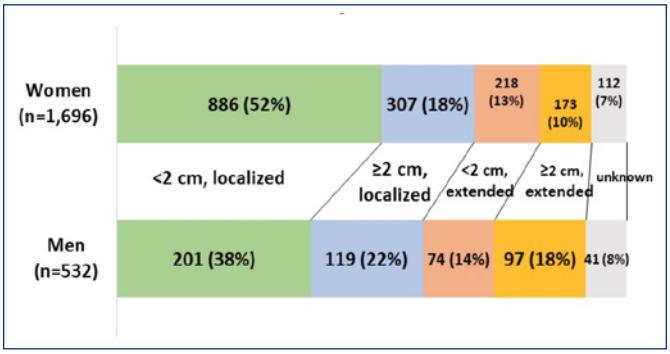
† Rates are per 100,000 and age-adjusted to the 2000 US Population Standard.
CI = confidence interval

Figure 1. Malignant thyroid cancer incidence trends among Rhode Island adults (ages ≥ 20 years) by Sex, 1995–2016 Rhode Island Cancer Registry



Rates are per 100,000 and age-adjusted to the 2000 US Population Standard.

Figure 2. Count and percent of papillary thyroid cancer among Rhode Island adults (ages ≥ 20 years) by sex, tumor size and stage* at diagnosis, 2004–2016 Rhode Island Cancer Registry



* A "localized" cancer is confined to the organ of origin without extension beyond the primary organ. An "extended" category combined "regional" and "distant" stages of cancer. "Regional" cancers spread to adjacent organ/structures or regional lymph nodes; "Distant" cancers spread to parts of the body remote from the primary tumor (thyroid gland).

carcinomas (**Table 2**). Although case counts were not as significant as those of papillary cancers, elevated incidence of follicular thyroid cancers were significant in both sexes over the study period. Women's follicular thyroid cancers incidence rate was twice as high between 2006 and 2016 as it was from 1995 to 2005 (rate ratio=2.38, **Table 2**). Among men, a similar but smaller extent of increased follicular thyroid cancer emerges (rate ratio=1.61, **Table 2**).

The remaining subtypes (anaplastic, medullary and other histologic subtypes combined) were less common – 3% and 7% of thyroid cancers among females and males, respectively (**Table 2**). Their rate changes over the study period were not statistically meaningful, due to small numbers of reported cases (less than three per year on average).

Papillary thyroid cancer by sex and age, and incidence changes

Demographic characteristics were summarized for papillary thyroid cancer. For both age groups (20–54 and ≥55 years), and for both women and men, papillary cancer incidence rates increased between the first decade studied and the second (**Table 3**). Although more cases were diagnosed among younger adults, the older adult cohort (≥55 years) showed higher rate ratios than the younger cohort (rate ratios for women: 2.47 among ≥55 years *vs*. 1.97 among 20–54 years; rate ratios for men: 2.39 among ≥55 years *vs*. 1.87 among 20–54 years).

Papillary thyroid cancer by tumor size and stage

Most papillary thyroid cancers were diagnosed at small sizes (<2 cm) and at localized stages (**Figure 2**). More women were diagnosed when their tumors were smaller than 2 cm and localized, compared with men (52% *vs*. 38%, **Figure 2**). Men were more likely to have papillary thyroid cancer diagnosed at larger sizes (≥2 cm) and at extended stages (when their tumors had spread to regional sites or lymph nodes, or metastasized – 18% *vs.* 10%, **Figure 2**).

DISCUSSION

The above assessment of demographic and tumor characteristics of thyroid cancer diagnosed among Rhode Island adults provides a more complete picture of thyroid cancer incidence by sex, age group, cancer type, and stage at diagnosis. However, these findings are subject to the following limitations: (1) further histologic variants in each subtype cancer were *not* differentiated or confirmed, using supplemental pathologic or treatment reports; and (2) additional risk factors that may contribute to development of cancer, such as ionizing radiation exposure history in childhood, genetic mutations, family history, comorbidity (e.g., obesity, diabetes), or lifestyle factors (e.g., physical activity, dietary intake, smoking history, etc.) were not collected in the registry database and are therefore not included in this study.

The incidence of thyroid cancer in Rhode Island (overall and papillary) was three times higher among women than men during the study period, consistent with national incidence trends. In 2016, thyroid cancer was the fifth most commonly diagnosed cancer among Rhode Island women.[3] Men also experienced a rapid and steady increase of thyroid cancers, statewide and nationally,[4,5] and it was typically diagnosed at later stages among Rhode Island men. Late-stage diagnosis of papillary thyroid cancer with larger tumor sizes among Rhode Island men is particularly concerning, since it may lead to worse prognoses and higher mortality rates.

The literature suggests that higher utilization of diagnostic tests using imaging may have resulted in more cases of thyroid cancer being diagnosed.[6,7,8] Improved thyroid cancer diagnoses alone may not explain patterns and changes in thyroid cancer incidence. Higher rates among women, particularly during reproductive years, may imply roles of biologic hormones.[9] Exposure to ionizing radiation may also play an important role in thyroid cancers, particularly the papillary subtype.[10] Other risk factors, behavioral or environmental, may differentially affect individuals' lifetime risks.[11] Increases in cancer detection among older adults may reflect opportunistic screening effect, symptom-based screening, increased risk as age advances, unknown factors, or multifactorial influences. More studies are needed to determine factors that may have influenced these increased cancer rates.

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