

Cancers Associated with Overweight or Obesity among Rhode Island Adults, 1995–2016

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Rhode Island’s adult obesity rate is currently 30 percent, up from 17 percent in 2000 and from 10 percent in 1990.^{1,2} Being overweight or obese can lead to a large number of health problems, including hypertension, high cholesterol, heart disease, diabetes, osteoarthritis, asthma, sleep apnea, infertility, poorer mental health, body pain, and as many as 13 types of cancers.³ Epidemiologic evidence has shown strong associations between excess body fat and cancer risk, explained by altering hormonal or inflammatory pathways.^{3,4}

To better address the burden of cancers associated with overweight or obesity among Rhode Island adults, the authors assessed statewide overweight- or obesity-associated cancer incidence by sex, cancer type and age group, in 2016 (the most current full year of data available in the central cancer registry), as well as incidence trends between 1995 and 2016.

METHODS

The Rhode Island Cancer Registry (RICR) has collected cancer case reports since October 1986. 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 primary cancers diagnosed in adults aged 20 years and older, from January 1, 1995 to December 31, 2016. Cancer registries have not routinely and consistently collected indicators of body fatness, throughout the data collection years. However, other sources of information can be used to obtain the proportion of cancer probably caused by overweight or obesity. According to the International Agency of Research on Cancer (IARC), 13 types are defined as “overweight- or obesity-associated” cancers. The scientists in the group reviewed and conducted meta-analyses and pooled analyses with more than a thousand studies. They found solid evidence that being overweight or obese increases the risk for at least 13 types of cancer [Table 1].³ Of these, two cancers, postmenopausal breast cancer and colorectal cancer, were **not** included in this study. This study assessed cancers that affect all adults (≥20 years of age), and calculated age-adjusted

Table 1. Overweight- or obesity-associated cancers defined by International Agency of Research on Cancer (IARC)*

Cancer site/type	Site [ICD-O-3] §	Histology [ICD-O-3] §
Adenocarcinoma of the esophagus	C15.0–15.9	8140–8575
Gastric cardia	C16.0	8000–9049, 9056–9139, 9141–9589
Colon and rectum†	C18.0–20.9, C26.0	
Liver	C22.0	
Gallbladder	C23.9	
Pancreas	C25.0–25.9	
Multiple Myeloma	C42.1	9732
Postmenopausal breast (female age ≥50 years)†	C50.0–50.9	8000–9049, 9056–9139, 9141–9589
Corpus Uterus & Uterus NOS	C54.0–54.9, C55.9	
Ovary	C56.9	
Kidney	C64.9	
Meningioma	C70.0–70.1, C70.9	9530–9539
Thyroid	C73.9	8000–9049, 9056–9139, 9141–9589

* IARC used the definitions overweight as a body-mass index (BMI) of 25.0-29.9, and obesity as a BMI of ≥30, among adults.

§ International Classification of Disease for Oncology, 3th edition

† Cancers in colon, rectum, and postmenopausal breast were not included in this study (see Methods).

incidence rates for 11 types of “overweight- or obesity-associated” cancers, using as denominators the full population at risk. Postmenopausal breast cancer, defined by IARC, is diagnosed in women aged ≥50 years, and its incidence is not directly comparable with other cancers. Colorectal cancer was also excluded to minimize bias by screening and treatment effects. Colorectal cancer rates have steadily decreased among Rhode Islanders for the last two decades, due both to increased screening rates and the early detection and removal of precancerous polyps.^{5,6}

SAS v9.4® statistical analytic software (SAS Institute Inc., Cary, NC) was used to summarize and tabulate frequencies by cancer type, diagnosis year (1995–2016), sex and age group (ages at diagnosis in 5-year intervals between 20–79 years, plus the category of ≥80 years). Jointpoint Regression

Analysis software v4.6.0.0 (<http://surveillance.cancer.gov/jointpoint/>) was used to calculate age-adjusted rates per 100,000 residents using the 2000 US standard population (<https://seer.cancer.gov/stdpopulations/>), and to assess trends between 1995 and 2016 with statistical significance testing of annual percent change (APC, p -value<0.05). 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>).

RESULTS

Current cancer incidence associated with overweight or obesity

In 2016, approximately 1,100 cancers in RI were categorized as overweight- or obesity-associated cancers, accounting for about 20% of the nearly 5,900 cancers diagnosed among Rhode Island adults.

Overweight- or obesity-associated cancer rates were higher among females than males (135 [95% CI:124–145] vs. 103 [95% CI:93–113] per 100,000), partly because 40% of these cancers among females occurred in the female genital organs (uterus and ovary). Among adult males, cancers of the kidney (30 per 100,000) and pancreas (22 per 100,000) were the most frequently diagnosed in 2016. In the same year, cancers of the uterus (40 per 100,000) and thyroid (35 per 100,000) were the most frequently diagnosed among females. Kidney cancer was twice as likely to occur in males than in females (30 [95% CI:24–35] vs. 15 [95% CI:11–18] per 100,000), and liver cancer incidence among males was three times higher than among females (15 [95% CI:12–19] vs. 5 [95% CI: 3–7] per 100,000). However, females had almost triple the rate of thyroid cancer among males (35 [95% CI:29–41] vs. 12 [95% CI:8–15] per 100,000). A majority (81%) of cancer diagnosed in females age 20–39 were thyroid cancer, which drove the age-specific rate three times higher than their male counterparts. For both sexes, about 50% of the overweight- or obesity-associated cancers were diagnosed in people 60–79 years of age [Table 2].

Trend of cancer incidence associated with overweight or obesity

Among males, incidence rates of the overweight- or obesity-associated cancers increased significantly between 1995 and 2003 by 4% annually, but between 2003 to 2016, these rates stabilized. Trends illustrate continuous increases in all age groups between 1995 and 2016, except the oldest (≥ 80 years). The youngest cohort (20–39 years) showed a sharper gradient of change (APC=5%) than older cohorts (APC=2% among 40–59 years; APC=1% among 60–79 years) [Table 3]. Among females, the cancer rates increased significantly by about 2% per year between 1995 and 2013. Similar to males, the youngest group of females ages 20–39 years showed a

Table 2. Case counts and age-adjusted rates of selective overweight- or obesity-associated cancers* by sex, age group, and cancer site, among Rhode Island adults ≥ 20 years, 2016 Rhode Island Cancer Registry

	Male		Female	
	Count	Rate (95% CI) [§]	Count	Rate (95% CI) [§]
All	445	103.0 (93.2–112.9)	662	134.7 (124.0–145.4)
Age group (years)				
20–39	15	12.4 (6.1–18.8)	53	40.5 (29.4–51.5)
40–59	123	76.6 (62.6–90.5)	207	124.9 (107.3–142.6)
60–79	260	308.0 (269.3–346.6)	322	325.3 (189.1–361.4)
≥ 80	47	271.6 (199.4–343.8)	80	258.3 (199.5–317.1)
Cancer site/type [†]				
Kidney	126	29.6 (24.2–35.0)	77	14.8 (11.4–18.1)
Pancreas	90	21.8 (17.1–26.4)	100	18.0 (14.3–21.7)
Liver	71	15.4 (11.7–19.1)	26	5.1 (3.1–7.1)
Thyroid	52	11.8 (8.4–15.1)	144	35.1 (29.1–41.0)
Multiple Myeloma	45	10.4 (7.3–13.6)	27	5.0 (3.1–7.0)
Adenocarcinoma of the Esophagus	33	7.1 (4.6–9.6)	†	†
Gastric cardia	23	5.7 (3.3–8.0)	†	†
Corpus uterus & uterus NOS	n/a		208	39.8 (34.3–45.3)
Ovary	n/a		52	11.0 (7.9–14.1)

* Cancers in the colon, rectum, and postmenopausal breast were not included in this study (see Methods).

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

[†] Due to confidentiality and reliability concerns, cancers with <15 cases are not presented.

95% CI = 95% confidence interval

sharper rate of increase than older age groups, from 1995 until 2009 (APC=7%) [Table 3].

Trends by cancer site showed kidney cancer among males increased between 1995 and 2007 (APC=4%). Liver cancer's increasing slope was noticeably steeper than other cancers, during the first part of the studied period (APC=9%, 1995–2004). Thyroid cancers steadily increased among males between 1995 and 2016, with a 5% annual increase [Table 3]. In women, thyroid cancer increased even more sharply (10% per year) than in men and other cancer sites, between 1995 and 2009. Kidney cancer showed a steady increase (APC=2%,

Table 3. Trend* of overweight- or obesity-associated cancer incidence among Rhode Island adults (ages ≥ 20 years) by sex, age at diagnosis and cancer site, 1995-2016 Rhode Island Cancer Registry

	Statistically Significant Jointpoint Segment*					
	Male			Female		
	Years	Rate changes [†]	APC	Years	Rate changes [†]	APC
All [§]	1995–2003	63.7–101.1	4.4%	1995–2013	105.6–154.9	1.9%
Age group (years)						
20–39	1995–2016	5.9–12.4	5.1%	1995–2009	17.8–60.6	7.4%
40–59	1995–2016	39.0–76.6	2.3%	1995–2007	89.9–147.9	3.6%
60–79	1995–2016	198.3–308.0	1.1%	1995–2016	251.6–325.3	1.0%
Cancer site/type						
Kidney	1995–2007	20.2–34.8	3.5%	1995–2016	9.2–14.8	2.0%
Liver	1995–2004	4.6–17.6	9.4%	Not significant		
Thyroid	1995–2016	4.8–11.8	5.2%	1995–2009	9.2–47.2	10.2%
Corpus uterus & uterus NOS	n/a			1995–2013	38.3–47.9	1.2%
Ovary	n/a			1995–2016	23.2–11.0	-2.1%

* Of different regression models tested by subgroup, presented in the tables are: only the best selected final model and time periods during which trend change was significant.

[§] Cancers in the colon, rectum, and postmenopausal breast were not included in this study (see Methods).

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

APC: Annual Percent Change

1995–2016), and uterine cancer increased at a lesser extent until recent years (APC=1%, 1995–2013). By contrast, ovarian cancer decreased significantly between 1995 and 2016 (APC=-2%) [Table 3].

DISCUSSION

Through the application of sophisticated trend analysis software, we provide a more complete picture of overweight- and obesity-associated cancer trends in Rhode Island, varied by sex, age group, and cancer type. However, these findings are subject to, but not limited to, the following limitations: (1) individual patient's body fat measurement (such as Body Mass Index) was *not* controlled in this descriptive study; (2) adjustment was *not* made for differential attributable risks by cancer site/type³; and (3) additional risk factors may have contributed to the cancers in this study, such as genetic mutations, family history, comorbidity, smoking, alcohol use, and more.

Despite these limitations, a significant portion of cancers among Rhode Islanders is associated with unhealthy body weight, and those cancers have increased with the tripling of obesity during the past generation. In 2016, in addition to the 1,100 cases summarized in this report, 1,200 cases of colon, rectal, and postmenopausal breast cancer were diagnosed. As many as 40% of all newly diagnosed cases of cancer in Rhode Island are those known to be associated with overweight status or obesity, an estimate parallel with the

recent U.S. Cancer Statistics representing the national population.⁷

For both sexes in Rhode Island and in the U.S., the steady increase in cancer diagnoses among younger adults is concerning.⁸ There is growing evidence of associations between elevated cancer rates and abnormal or excessive body weight in childhood (even at birth) and early adulthood.⁸ More studies are needed to determine the role that body weight may play in cancer types, sites, staging and other risk factors among Rhode Island's young adult patients.

Of the cancers in this report, thyroid cancer incidence was three times higher among Rhode Island females than males throughout the study period, though men also experienced a rapid and steady increase of the thyroid cancer, similar to national trends.^{9,10} Additional epidemiological research by cancer subtype, tumor size, stage at diagnosis, patients' demographic attributes and survival is needed to identify underlying reasons for the rising rates of thyroid cancer in Rhode Island.

The evidence is clear that obesity increases the risks of a range of chronic conditions. Despite extensive public health campaigns seeking to explain the health risks of excess body weight, public awareness is still low in perceiving obesity as a factor associated with cancer.⁷ Rhode Island's cancer control efforts have not yet emphasized obesity control as a means of cancer prevention, like targeting smoking. It is hoped that this assessment will help to guide providers and community partners in implementing weight reduction among other evidence-based cancer control strategies.

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Disclosure

The authors declare no conflict of interest.

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