IARC HANDBOOKS

ABSENCE OF EXCESS BODY FATNESS

VOLUME 16

This publication represents the views and expert opinions of an IARC Working Group on the Evaluation of Cancer-Preventive Interventions, which met in Lyon, 5–12 April 2016

LYON, FRANCE - 2018

IARC HANDBOOKS OF CANCER PREVENTION

International Agency for Research on Cancer

World Health Organization

2.2.19 Cancer of the thyroid

Cancer of the thyroid includes a variety of histological types, ranging from the most common group of differentiated cancers (papillary carcinoma and follicular carcinoma) to medullary carcinoma and anaplastic (undifferentiated) carcinoma. Globally, thyroid cancer incidence has been increasing during the past three decades; incidence rates in women are generally 2–3 times those in men. Known risk factors include exposure to radiation for all thyroid cancers, and iodine deficiency for follicular carcinoma.

In 2001, the Working Group of the *IARC Handbook* on weight control and physical activity (IARC, 2002) concluded that the evidence of an association between avoidance of weight gain and thyroid cancer was *inadequate*. The 2007 WCRF review did not draw any conclusions about body fatness and thyroid cancer risk (WCRF/AICR, 2007).

(a) Cohort studies

The evidence from cohort studies since 2000 includes 15 publications (excluding analyses that were later updated and analyses based on fewer than 100 incident cases), including a large pooled analysis of 22 cohorts (Kitahara et al., 2016). Table 2.2.19a presents results from these studies for BMI at baseline, with comments on findings according to other measures of body fatness, such as weight changes over the life-course, waist circumference, or waist-to-hip ratio.

In general, the evidence from cohort studies supports a positive association between BMI and thyroid cancer, with most studies reporting a significantly increased risk at the highest versus lowest category of BMI and/or a significant dose–response relationship. However, in those studies that provided estimates for women and men separately, inconsistent findings were observed across studies. Almquist et al. (2011) found no association between BMI and thyroid cancer in either sex, but a positive trend across BMI quintiles in women only ($P_{trend} = 0.02$). In a Norwegian population-based cohort, Engeland et al. (2006) observed no association in men, but a positive association in women; the estimated relative risk for BMI ≥ 30 kg/m^2 compared with the reference BMI of 18–24.9 kg/m^2 was 1.29 (95% CI, 1.13–1.46). In the Radiologic Technologists Study in the USA (Meinhold et al. (2010), no association was observed in men, whereas the association in women was also positive (RR, 1.74; 95% CI, 1.03–2.94). A systematic review, including 11 studies, estimated the relative risk of thyroid cancer for obese compared with normal-weight individuals to be 1.53 (95% CI, 0.89–2.64) in men and 1.57 (95% CI, 1.13–2.19) in women (Schmid et al., 2015). Another systematic review (Zhang et al., 2014), including 16 cohort studies, estimated an overall relative risk of thyroid cancer of 1.29 (95% CI, 1.20–1.37) in relation to obesity, with similar risk estimates in men and in women [the Working Group noted that this study provided limited information]. A pooled analysis by Kitahara et al. (2016) of 22 cohorts including 2296 incident cases found a modest positive association between baseline BMI and thyroid cancer risk overall, and the association was stronger in men (RR per 5 kg/m^2, 1.17; 95% CI, 1.06–1.28) than in women (RR per 5 kg/m^2, 1.04; 95% CI, 1.00–1.09).

A total of four studies assessed the association between body fatness and thyroid cancer risk by histological subtype (Engeland et al., 2006; Kabat et al., 2012; Rinaldi et al., 2012; Kitahara et al., 2016). The association with BMI was similar for the papillary and follicular histological subtypes.

In the only study that assessed BMI at younger ages (Kitahara et al., 2016), thyroid cancer risk was similar for BMI in young adulthood (RR per 5 kg/m^2, 1.13; 95% CI, 1.02–1.25) and BMI later in adult life (RR per 5 kg/m^2, 1.06; 95% CI, 1.02–1.10); a positive association was also reported with BMI gain in adult life (RR per 5 kg/m^2, 1.07; 95% CI, 1.00–1.15), after adjustment for BMI.

Two studies assessed anthropometric measures of body fatness other than BMI. In the pooled analysis by Kitahara et al. (2016), a weaker positive association was found with waist circumference (RR per 5 cm, 1.03; 95% CI, 1.01–1.05) than with BMI (RR per 5 kg/m^2, 1.06; 95% CI, 1.02–1.10). In the EPIC cohort (Rinaldi et al., 2012), associations with waist circumference and waist-to-hip ratio were similar to those observed with BMI.

(b) Case–control studies

Six informative case–control studies were identified that evaluated the association between BMI and thyroid cancer, including two larger pooled analyses (Table 2.2.19b). One study (Cléro et al., 2010) that combined two of the five studies but that did not offer additional information was excluded. In two studies, the total number of cases in men was less than 50 (Guignard et al., 2007; Suzuki et al., 2008); therefore, only data for women are reported. Two studies (Guignard et al., 2007; Xu et al., 2014) were restricted to papillary carcinomas.

Overall, there appeared to be an association between elevated current BMI (in adulthood) and the occurrence of thyroid cancer. There was some indication that this relationship was stronger in women than in men. [However, this may reflect small case numbers in the studies, especially in men, related to the low prevalence of the disease.] Two of the studies evaluated the associations between BMI at age 18 years (Brindel et al., 2009) and at age 20 years (Suzuki et al., 2008) and thyroid cancer, and noted some evidence for an association with thyroid cancer occurrence.

Table 2.2.19a Cohort studies of measures of body fatness and cancer of the thyroid

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence or mortality	Obesity Non-obese Obese Non-obese Obese	 White men: 811 64 Black men: 156 13	 1.00 1.40 (1.09–1.81) 1.00 1.92 (1.09–3.40)	Age, calendar year	Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0 Cancers diagnosed within 1 yr of obesity diagnoses were excluded from the study In White men only, higher risk of adrenal thyroid cancer
Oh et al. (2005) Korea National Health Insurance Corporation cohort Republic of Korea 1992–2002	781 283 Men	BMI < 18.5 18.5–22.9 23–24.9 25–26.9 27–29.9 ≥ 30 [P_{trend}]	 3 72 70 53 28 – 	 0.82 (0.20–3.34) 1.00 1.52 (1.07–2.14) 2.00 (1.38–2.89) 2.23 (1.40–3.55) – [< 0.001]	Age, smoking, alcohol consumption, exercise, family history of cancer, area of residence	
Engeland et al. (2006) Norwegian population-based cohort Norway 1972–2003	963 523 Men Incidence	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 2 412 322 42 	 0.47 (0.12–1.87) 1.00 1.12 (0.97–1.30) 1.14 (0.82–1.56) [0.005]	Age	Association was similar for age 50–74 yr
	1 037 424 Women Incidence	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 30 1187 710 341 	 0.68 (0.47–0.98) 1.00 1.08 (0.98–1.20) 1.29 (1.13–1.46) [0.001]	Age	Association was similar for age 20–49 yr and stronger for age 50–74 yr (57% increased risk). Somewhat stronger associations for follicular carcinoma vs papillary carcinoma
Samanic et al. (2006) Swedish Construction Worker Cohort Sweden 1971–1999	362 552 Men Incidence	BMI 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 89 73 9 	 1.00 1.24 (0.90–1.71) 0.98 (0.49–1.96) [0.48]	Age, calendar year, smoking	

Table 2.2.19a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Song et al. (2008) Female public servants Republic of Korea 1994–2003	170 481 Women	BMI < 18.5 18.5–20.9 21–22.9 23–24.9 25–26.9 27–29.9 ≥ 30 per 1 kg/m^2	 3 40 89 115 93 59 11	 0.35 (0.11–1.10) 0.78 (0.52–1.16) 1.00 1.05 (0.79–1.41) 1.08 (0.80–1.47) 1.02 (0.72–1.45) 0.70 (0.35–1.40) 1.02 (0.98–1.04)	Age, height, smoking, alcohol consumption, exercise, SES	
Clavel-Chapelon et al. (2010) E3N cohort (female teachers) France 1990–2005	91 909 Women	BMI < 18.5 18.5–22 22–25 25–30 ≥ 30 [P_{trend}]	 3 99 129 62 24	 0.35 (0.11–1.12) 1.00 1.39 (1.07–1.81) 1.18 (0.86–1.63) 1.76 (1.12–2.76) [0.005]	Age, year of birth, history of benign thyroid conditions, smoking, iodine	Large body shape (Sörensen's silhouette) at baseline and at age 35–40 yr, but not at age 20–25 yr, associated with increased risk
Leitzmann et al. (2010) NIH-AARP cohort USA 1995–2003	484 326 Men and women Incidence	BMI 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 107 153 92	 1.00 1.27 (0.99–1.64) 1.39 (1.05–1.85) [0.007]	Age, sex, physical activity, race/ethnicity, education level, smoking, alcohol consumption, OC use	For WC, positive association in men but not in women. For waist-to-hip ratio, null association in either sex
Meinhold et al. (2010) Radiologic Technologists Study USA 1983–2006	21 207 Men Incidence	BMI 18.5–24.9 25–29.9 30–34.5 ≥ 35 [P_{trend}]	 13 15 9 2	 1.00 0.89 (0.42–1.90) 1.91 (0.80–4.56) 2.14 (0.60–7.67) [0.11]	Year of birth, smoking, radiation exposure, history of benign thyroid conditions	
	69 506 Women Incidence	BMI < 18.5 18.5–24.9 25–29.9 30–34.5 ≥ 35 [P_{trend}]	 6 144 44 26 16	 0.96 (0.42–2.18) 1.00 0.90 (0.64–1.27) 1.41 (0.92–2.16) 1.74 (1.03–2.94) [0.04]		

Table 2.2.19a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Almquist et al. (2011) 7 population-based cohorts Austria, Norway, and Sweden 2006–2016	289 866 Men Incidence	BMI, quintiles			Age, smoking	
		Q1	23	1.00		
		Q2	35	1.41 (0.83–2.39)		
		Q3	20	0.77 (0.42–1.41)		
		Q4	29	1.09 (0.63–1.89)		
		Q5	26	1.00 (0.57–1.77)		
		[P_{trend}]		[0.61]		
	288 834 Women Incidence	BMI, quintiles			Age, smoking	
		Q1	41	1.00		
		Q2	37	0.84 (0.54–1.31)		
		Q3	51	1.10 (0.73–1.68)		
		Q4	59	1.22 (0.81–1.84)		
		Q5	67	1.40 (0.93–2.09)		
		[P_{trend}]		[0.02]		
Kabat et al. (2012) Women's Health Initiative USA 1993–2011	144 319 Women Incidence	BMI			Age, age at first pregnancy, education level, smoking, alcohol consumption, exercise, history of benign thyroid conditions	Waist-to-hip ratio and weight change, null association. Similar associations for papillary carcinoma and follicular carcinoma
		< 25	92	1.00		
		25– < 30	99	1.06 (0.79–1.42)		
		30–35	71	1.40 (1.00–1.94)		
		≥ 35	32	0.97 (0.62–1.50)		
		[P_{trend}]		[0.39]		
Rinaldi et al. (2012) EPIC cohort Europe 1992–2009	343 765 Women Incidence	BMI			Age, centre, smoking	Only 58 incident cases identified in men (results not presented). Similar findings for papillary carcinoma only. WC and waist-to-hip ratio both positively associated with risk
		< 18.5	3	0.27 (0.09–0.84)		
		18.5–24.9	290	1.00		
		25–29.9	145	1.12 (0.91–1.38)		
		≥ 30	66	1.19 (0.89–1.59)		
		[P_{trend}]	4	[0.042]		
Bhaskaran et al. (2014) Clinical Practice Research Datalink United Kingdom 1987–2012	5.24 million Men and women Incidence	BMI per 5 kg/m^2	941	1.09 (1.00–1.19)	Age, sex, year, diabetes, alcohol consumption, smoking, SES	Similar association in never-smokers

Table 2.2.19a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Kitahara et al. (2016) Pooled analysis of 22 cohorts Asia, Australia, Europe, and North America 1979–2009	578 922 Men Incidence	BMI 15–18.4 18.5–24.9 25–29.9 ≥ 30 per 5 kg/m^2	 2 191 327 129	 0.66 (0.16–2.67) 1.0 1.23 (1.02–1.47) 1.35 (1.07–1.71) 1.17 (1.06–1.28)	Age, alcohol consumption, physical activity, race/ethnicity, marital status, education level, smoking	WC less associated. Similar associations for papillary carcinoma and follicular carcinoma
	774 373 Women Incidence	BMI 15–18.4 18.5–24.9 25–29.9 ≥ 30 per 5 kg/m^2 BMI at baseline per 5 kg/m^2 BMI in young adulthood per 5 kg/m^2 BMI gain in adult life per 5 kg/m^2	 29 995 615 356	 0.86 (0.59–1.24) 1.0 1.02 (0.93–1.14) 1.05 (0.92–1.19) 1.04 (1.00–1.09) 1.06 (1.02–1.10) 1.13 (1.02–1.25) 1.07 (1.00–1.15)		Similar associations for WC. Similar associations for papillary carcinoma and follicular carcinoma

BMI, body mass index (in kg/m^2); CI, confidence interval; EPIC, European Prospective Investigation into Cancer and Nutrition; NIH-AARP, National Institutes of Health–AARP Diet and Health Study; OC, oral contraceptive; SES, socioeconomic status; WC, waist circumference; yr, year or years

Table 2.2.19b Case–control studies of measures of body fatness and cancer of the thyroid

Reference Study location Period	Total number of cases Sex Source of controls	Exposure categories	Exposed cases	Odds ratio (95% CI)	Adjustment for confounding	Comments
Dal Maso et al. (2000) Pooled analysis of 12 case–control studies China, Greece, Italy, Japan, Norway, Sweden, Switzerland, and USA	Men: 417 Women: 2056 Population and hospital	BMI, tertiles T1 T2 T3 [P_{trend}] BMI, tertiles T1 T2 T3 [P_{trend}]	NR NR 	Men: 1.0 0.8 (0.6–1.1) 1.0 (0.8–1.4) [0.71] Women: 1.0 1.0 (0.9–1.2) 1.2 (1.0–1.4) [0.04]	Age, history of radiation exposure	
Guignard et al. (2007) New Caledonia 1993–1999	Women: 279 Population	BMI <18.5 18.5–24.99 25.0–29.9 30.0–34.9 ≥ 35.0 [P_{trend}]	 7 80 87 61 41 	 0.99 (0.35–2.80) 1.00 1.18 (0.75–1.86) 1.92 (1.14–3.22) 1.85 (1.02–3.35) [0.01]	Age, reference year, ethnicity, smoking, number of full-term pregnancies, miscarriages, and irregular menstruations	Papillary and follicular carcinomas only The risk was greater in women aged > 50 yr Data for men NR because of the low number of cases
Suzuki et al. (2008) Japan 2001–2005	Women: 131 Hospital	Current BMI, tertiles 15.4–20.4 20.4–22.9 22.9–37.0 [P_{trend}] BMI at age 20 yr, tertiles 14.9–19.2 19.3–21.1 21.2–33.4 [P_{trend}]	 31 51 49 31 45 50 	 1.00 1.01 (0.59–1.74) 1.48 (0.86–2.57) [0.141] 1.00 1.42 (0.85–2.38) 1.18 (0.69–2.01) [0.526]	Age, smoking habits, drinking habits, regular exercise, family history of thyroid cancer, past history of thyroid diseases, total non-alcohol energy intake, referral pattern to the hospital, menopausal status, age at menarche, parity, HRT use	Papillary and follicular carcinomas only Null associations with BMI or weight change since age 20 yr Data for men NR because of the low number of cases

Table 2.2.19b (continued)

Reference Study location Period	Total number of cases Sex Source of controls	Exposure categories	Exposed cases	Odds ratio (95% CI)	Adjustment for confounding	Comments
Brindel et al. (2009) French Polynesia 1979–2004	Men: 23 Women: 177 Population; matched by date of birth and sex	BMI before diagnosis			Height, ethnicity, education level, smoking, interviewer, radiation to head or neck before age 15 yr In women, also adjusted for number of full-term pregnancies, menopausal status	
			Men:			
		< 18.5	0	–		
		18.5–24.9	7	1.0		
		25.0–29.9	11	5.9 (0.8–40.8)		
		30.0–34.9	2	3.1 (0.2–42.1)		
		≥ 35.0	3	3.2 (0.3–39.2)		
			Women:			
		< 18.5	7	0.8 (0.3–2.4)		
		18.5–24.9	74	1.0		
		25.0–29.9	44	3.5 (1.7–7.4)		
		30.0–34.9	25	1.2 (0.6–2.6)		
		≥ 35.0	27	3.0 (1.3–7.1)		
		BMI at age 18 yr				
			Men:			
		< 18.5	1	0.05 (0.0–1.0)		
		18.5–24.9	16	1.0		
		25.0–29.9	3	0.8 (0.1–6.3)		
		≥ 30.0	2	4.8 (0.2–113)		
			Women:			
		< 18.5	26	0.6 (0.3–1.2)		
		18.5–24.9	117	1.0		
		25.0–29.9	32	3.7 (1.6–8.4)		
		≥ 30.0	5	1.2 (0.3–5.2)		
Xu et al. (2014) Pooled analysis Germany, Italy, USA 1993–2013	Men: 557 Women: 1360 Hospital	BMI			Age, sex, race/ethnicity, study centre	Papillary carcinoma only. Body fat percentage (calculated by the formula of Deurenberg) also associated with increased risk, overall and by sex
		< 18.5	35	0.82 (0.52–1.30)		
		18.5–24.9	581	1.00		
		25–29.9	422	1.67 (1.38–2.03)		
		≥ 30	319	3.91 (3.02–5.05)		
		[P_{trend}]		[0.001]		

Table 2.2.19b (continued)

Reference Study location Period	Total number of cases Sex Source of controls	Exposure categories	Exposed cases	Odds ratio (95% CI)	Adjustment for confounding	Comments
Xhaard et al. (2015) France 2005–2010	Men and women: 761 Population	BMI	All:		Stratified by sex, region, and age and adjusted for education level, ethnicity, smoking status, family history of thyroid cancer, and number of pregnancies (in women only)	No differences in risk were observed when restricting to papillary carcinomas (n = 676 cases)
		< 18.5	52	1.00		
		18.5–24.9	496	1.15 (0.77–1.71)		
		25–29.9	138	1.23 (0.77–1.96)		
		≥ 30	72	1.56 (0.92–2.66)		
		[P_{trend}]		[0.09]		
		BMI	Women:			
		< 18.5	45	1.00		
		18.5–24.9	384	1.25 (0.82–1.90)		
		25–29.9	102	1.50 (0.89–2.51)		
		≥ 30	65	1.78 (1.01–3.14)		
		[P_{trend}]		[0.03]		

BMI, body mass index (in kg/m²); CI, confidence interval; HRT, hormone replacement therapy; NR, not reported; yr, year or years

References

Almquist M, Johansen D, Björge T, Ulmer H, Lindkvist B, Stocks T, et al. (2011). Metabolic factors and risk of thyroid cancer in the Metabolic Syndrome and Cancer Project (Me-Can). *Cancer Causes Control*, 22(5):743–51. doi:10.1007/s10552-011-9747-2 PMID:21380729

Bhaskaran K, Douglas I, Forbes H, dos-Santos-Silva I, Leon DA, Smeeth L (2014). Body-mass index and risk of 22 specific cancers: a population-based cohort study of 5.24 million UK adults. *Lancet*, 384(9945):755–65. doi:10.1016/S0140-6736(14)60892-8 PMID:25129328

Brindel P, Doyon F, Rachédi F, Boissin JL, Sebbag J, Shan L, et al. (2009). Anthropometric factors in differentiated thyroid cancer in French Polynesia: a case-control study. *Cancer Causes Control*, 20(5):581–90. doi:10.1007/s10552-008-9266-y PMID:19043789

Clavel-Chapelon F, Guillas G, Tondeur L, Kernaleguen C, Boutron-Ruault MC (2010). Risk of differentiated thyroid cancer in relation to adult weight, height and body shape over life: the French E3N cohort. *Int J Cancer*, 126(12):2984–90. PMID:19950225

Cléro E, Leux C, Brindel P, Truong T, Anger A, Teinturier C, et al. (2010). Pooled analysis of two case-control studies in New Caledonia and French Polynesia of body mass index and differentiated thyroid cancer: the importance of body surface area. *Thyroid*, 20(11):1285–93. doi:10.1089/thy.2009.0456 PMID:20932181

Dal Maso L, La Vecchia C, Franceschi S, Preston-Martin S, Ron E, Levi F, et al. (2000). A pooled analysis of thyroid cancer studies. V. Anthropometric factors. *Cancer Causes Control*, 11(2):137–44. doi:10.1023/A:1008938520101 PMID:10710197

Engeland A, Tretli S, Akslen LA, Bjørge T (2006). Body size and thyroid cancer in two million Norwegian men and women. *Br J Cancer*, 95(3):366–70. doi:10.1038/sj.bjc.6603249 PMID:16832414

Guignard R, Truong T, Rougier Y, Baron-Dubourdieu D, Guénel P (2007). Alcohol drinking, tobacco smoking, and anthropometric characteristics as risk factors for thyroid cancer: a countrywide case-control study in New Caledonia. *Am J Epidemiol*, 166(10):1140–9. doi:10.1093/aje/kwm204 PMID:17855390

IARC (2002). Weight control and physical activity. Lyon, France: IARC Press (IARC Handbooks of Cancer Prevention, Vol. 6). Available from: http://publications.iarc.fr/376.

Kabat GC, Kim MY, Thomson CA, Luo J, Wactawski-Wende J, Rohan TE (2012). Anthropometric factors and physical activity and risk of thyroid cancer in postmenopausal women. *Cancer Causes Control*, 23(3):421–30. doi:10.1007/s10552-011-9890-9 PMID:22212611

Kitahara CM, McCullough ML, Franceschi S, Rinaldi S, Wolk A, Neta G, et al. (2016). Anthropometric factors and thyroid cancer risk by histological subtype: pooled analysis of 22 prospective studies. *Thyroid*, 26(2):306–18. doi:10.1089/thy.2015.0319 PMID:26756356

Leitzmann MF, Brenner A, Moore SC, Koebnick C, Park Y, Hollenbeck A, et al. (2010). Prospective study of body mass index, physical activity and thyroid cancer. *Int J Cancer*, 126(12):2947–56. PMID:19795465

Meinhold CL, Ron E, Schonfeld SJ, Alexander BH, Freedman DM, Linet MS, et al. (2010). Nonradiation risk factors for thyroid cancer in the US Radiologic Technologists Study. *Am J Epidemiol*, 171(2):242–52. doi:10.1093/aje/kwp354 PMID:19951937

Oh SW, Yoon YS, Shin SA (2005). Effects of excess weight on cancer incidences depending on cancer sites and histologic findings among men: Korea National Health Insurance Corporation Study. *J Clin Oncol*, 23(21):4742–54. doi:10.1200/JCO.2005.11.726 PMID:16034050

Rinaldi S, Lise M, Clavel-Chapelon F, Boutron-Ruault MC, Guillas G, Overvad K, et al. (2012). Body size and risk of differentiated thyroid carcinomas: findings from the EPIC study. *Int J Cancer*, 131(6):E1004–14. doi:10.1002/ijc.27601 PMID:22511178

Samanic C, Chow WH, Gridley G, Jarvholm B, Fraumeni JF Jr (2006). Relation of body mass index to cancer risk in 362,552 Swedish men. *Cancer Causes Control*, 17(7):901–9. doi:10.1007/s10552-006-0023-9 PMID:16841257

Samanic C, Gridley G, Chow WH, Lubin J, Hoover RN, Fraumeni JF Jr (2004). Obesity and cancer risk among white and black United States veterans. *Cancer Causes Control*, 15(1):35–43. doi:10.1023/B:CACO.0000016573.79453.ba PMID:14970733

Schmid D, Ricci C, Behrens G, Leitzmann MF (2015). Adiposity and risk of thyroid cancer: a systematic review and meta-analysis. *Obes Rev*, 16(12):1042–54. doi:10.1111/obr.12321 PMID:26365757

Song YM, Sung J, Ha M (2008). Obesity and risk of cancer in postmenopausal Korean women. *J Clin Oncol*, 26(20):3395–402. doi:10.1200/JCO.2007.15.7867 PMID:18612154

Suzuki T, Matsuo K, Hasegawa Y, Hiraki A, Kawase T, Tanaka H, et al. (2008). Anthropometric factors at age 20 years and risk of thyroid cancer. *Cancer Causes Control*, 19(10):1233–42. doi:10.1007/s10552-008-9194-x PMID:18618280

WCRF/AICR (2007). Food, nutrition, physical activity, and the prevention of cancer: a global perspective. Washington (DC), USA: American Institute for Cancer Research. Available from: http://www.aicr.org/assets/docs/pdf/reports/Second_Expert_Report.pdf.

Xhaard C, de Vathaire F, Cléro E, Maillard S, Ren Y, Borson-Chazot F, et al. (2015). Anthropometric risk factors for differentiated thyroid cancer in young men and women from eastern France: a case-control study. *Am J Epidemiol*, 182(3):202–14. doi:10.1093/aje/kwv048 PMID:26133374

Xu L, Port M, Landi S, Gemignani F, Cipollini M, Elisei R, et al. (2014). Obesity and the risk of papillary thyroid cancer: a pooled analysis of three case-control studies. *Thyroid*, 24(6):966–74. doi:10.1089/thy.2013.0566 PMID:24555500

Zhang W, Bai X, Ge H, Cui H, Wei Z, Han G (2014). Meta-analysis in the association between obesity and risk of thyroid cancer. *Int J Clin Exp Med*, 7(12):5268–74. PMID:25664030