

ABSENCE OF EXCESS BODY FATNESS

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Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments
<i>Oral cavity</i>						
Bhaskaran et al. (2014) Clinical Practice Research Datalink United Kingdom 1987–2012	5 243 978 Men and women Incidence	Oral cavity ICD-10: C00–C06	BMI per 5 kg/m ² [<i>P</i> _{trend}]	7976 total	0.81 (0.74–0.89) [< 0.0001]	Age, diabetes, smoking, alcohol consumption, socioeconomic status, calendar year, sex
Etemadi et al. (2014) NIH-AARP cohort USA 1995–2006	218 854 Men and women Incidence	Oral cavity	BMI < 18.5 18.5– < 25 25– < 30 ≥ 30 [<i>P</i> _{trend}] WC, quartiles Q1 Q2 Q3 Q4 [<i>P</i> _{trend}]	2 112 120 39 56 50 101 66	0.88 (0.22–3.57) 1.00 0.90 (0.69–1.18) 0.76 (0.52–1.11) [0.17] 1.00 1.14 (0.77–1.69) 2.01 (1.39–2.91) 2.00 (1.24–3.23) [< 0.001]	Age, sex, marital status, cigarette smoking, education level, ethnicity, alcohol consumption, physical activity, fruit and vegetable intake
Gaudet et al. (2015) Pooled analysis of 20 cohorts Follow-up varied by cohort	1 941 300 Men and women Incidence	Oral cavity ICD-10: C02.0–02.3, 03.0, 03.1, 03.9, 04.0, 04.1, 04.8, 04.9, 05.0, 06.0–06.2, 06.8, 06.9 ICD-9: 141.1–141.5, 143.0, 143.1, 143.8, 143.9, 144.0, 144.1, 144.8, 144.9, 145.0–145.2, 145.6, 145.8, 145.9	BMI per 5 kg/m ² [<i>P</i> _{trend}] WC per 5 cm [<i>P</i> _{trend}]	931 total	1.10 (0.97–1.25) [0.14] 1.09 (1.03–1.16) [0.006]	Age, sex, genetic ancestry, cohort, education level, alcohol consumption, smoking

Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments
<i>Pharynx (nasopharynx, oropharynx, and/or hypopharynx)</i>						
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence	Nasopharynx ICD-9: 147	Obesity Non-obese Obese Non-obese Obese	White men: 578 32 Black men: 165 6	1.00 0.91 (0.64–1.31) 1.00 0.76 (0.34–1.73)	Age, calendar year Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0
Gaudet et al. (2012) Cancer Prevention Study II Nutrition Cohort USA 1992–2007	150 262 Men and women Incidence	Oropharynx	BMI < 22.5 22.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	11 16 29 8	0.99 (0.45–2.16) 1.00 1.04 (0.56–1.93) 0.89 (0.38–2.09) [0.74]	Sex, education level, alcohol consumption, smoking, age
Gaudet et al. (2012) Cancer Prevention Study II USA 1982–2008	1 074 914 Men and women Mortality	Oropharynx	BMI < 22.5 22.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	53 48 65 17	1.35 (0.91–2.02) 1.00 0.89 (0.61–1.30) 1.00 (0.57–1.74) [0.14]	Sex, race, education level, alcohol consumption, smoking, age
Etemadi et al. (2014) NIH-AARP cohort USA 1995–2006	218 854 Men and women Incidence	Oropharynx and hypopharynx	BMI < 18.5 18.5– < 25 25– < 30 ≥ 30 [<i>P</i> _{trend}] WC, quartiles Q1 Q2 Q3 Q4 [<i>P</i> _{trend}]	3 39 47 12 28 22 26 25	4.20 (1.28–13.81) 1.00 0.93 (0.60–1.44) 0.61 (0.31–1.18) [0.05] 1.00 1.05 (0.59–1.87) 0.04 (0.56–1.90) 1.53 (0.72–3.25) [0.34]	Age, sex, marital status, cigarette smoking, education level, ethnicity, alcohol consumption, physical activity, fruit and vegetable intake

Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments
Gaudet et al. (2015) Pooled analysis of 20 cohorts Follow-up varied by cohort	1 941 300 Men and women Incidence	Oropharynx ICD-10: C01.9, 02.4, 05.1, 05.2, 09.0, 09.1, 09.8, 09.9, 10.0–10.4, 10.8, 10.9 ICD-9: 141.0, 141.6, 145.3, 145.4, 146.1, 146.2	BMI per 5 kg/m ² [<i>P</i> _{trend}]	972 total	0.98 (0.84–1.14) [0.77]	Age, sex, genetic ancestry, cohort, education level, alcohol consumption, smoking
			WC per 5 cm [<i>P</i> _{trend}]		0.99 (0.92–1.08) [0.86]	
	1 941 300 Men and women Incidence	Hypopharynx ICD-10: C12, 13.0– 13.2, 13.8, 13.9 ICD-9: 148.0–148.3, 148.8, 148.9	BMI per 5 kg/m ² [<i>P</i> _{trend}]	201 total	0.96 (0.55–1.67) [0.88]	Age, sex, genetic ancestry, cohort, education level, alcohol consumption, smoking
			WC per 5 cm [<i>P</i> _{trend}]		0.91 (0.70–1.20) [0.51]	
<i>Larynx</i>						
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence	Larynx ICD-9: 161	Obesity	White men: 10 555 515	1.00 0.77 (0.71–0.85)	Age, calendar year Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0
			Non-obese Obese			
Etemadi et al. (2014) NIH-AARP cohort USA 1995–2006	218 854 Men and women Incidence	Larynx	BMI < 18.5 18.5– < 25 25– < 30 ≥ 30 [<i>P</i> _{trend}]	3 79 90 39	2.18 (0.68–6.98) 1.00 0.89 (0.65–1.21) 1.04 (0.70–1.55) [0.79]	Age, sex, marital status, cigarette smoking, education level, ethnicity, alcohol consumption, physical activity, fruit and vegetable intake
			WC, quartiles			
			Q1	58	1.00	
			Q2	41	0.81 (0.53–1.22)	
			Q3	55	0.80 (0.53–1.22)	
			Q4	57	0.98 (0.58–1.66)	
[<i>P</i> _{trend}]		[0.99]				

Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments
Gaudet et al. (2015) Pooled analysis of 20 cohorts Follow-up varied by cohort	1 941 300 Men and women Incidence	Larynx ICD-10: C32.0–32.3, 32.8, 32.9 ICD-9: 161.0–161.3, 161.8, 161.9	BMI per 5 kg/m ² [<i>P</i> _{trend}] WC per 5 cm [<i>P</i> _{trend}]	1342 total	1.42 (1.19–1.70) [0.0001] 1.10 (0.99–1.22) [0.08]	Age, sex, genetic ancestry, cohort, education level, alcohol consumption, smoking
<i>Oral cavity, pharynx, and larynx combined</i>						
Andreotti et al. (2010) Agricural Health Study 1993–2005	39 628 Men Incidence	Oral cavity, pharynx, and larynx	BMI < 18.5 18.5–24.9 25–29.9 30–34.9 ≥ 35 Trend	0 24 61 13 2	– 1.00 1.30 (0.79–2.13) 0.69 (0.34–1.44) – 0.97 (0.92–1.02)	Race, smoking status, vegetable consumption, exercise, family history of cancer, age
	28 319 Women Incidence	Oral cavity, pharynx, and larynx	BMI < 18.5 18.5–24.9 25–29.9 30–34.9 ≥ 35 Trend	0 6 7 3 0	– 1.00 1.12 (0.34–3.69) – – 1.00 (0.89–1.11)	
Parr et al. (2010) Asia-Pacific Cohort Studies Collaboration 1961–1999 Average follow-up 4 yr	326 387 Men and women Mortality	Oropharynx and larynx ICD-9: 140–149, 161 ICD-10: C00–C14, C32	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 per 5 kg/m ² [<i>P</i> _{trend}]	16 79 25 34 5	1.79 (1.03–3.12) 1.00 (0.82–1.23) 0.61 (0.43–0.86) 0.39 (0.16–0.97) 0.60 (0.44–0.82) [0.009]	Age, sex, smoking
Gaudet et al. (2012) Cancer Prevention Study II USA 1982–2008	1 074 914 Men and women Mortality	Oral cavity, hypopharynx, and larynx	BMI < 22.5 22.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	325 336 390 85	1.28 (1.10–1.50) 1.00 0.75 (0.64–0.86) 0.74 (0.59–0.95) [5.1 × 10 ⁻¹⁰]	Sex, race, education level, alcohol consumption, smoking, age

Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments
Gaudet et al. (2012) Cancer Prevention Study II Nutrition Cohort USA 1992–2007	150 262 Men and women Incidence	Oral cavity, hypopharynx, and larynx	BMI < 22.5 22.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	47 69 121 39	1.06 (0.73–1.55) 1.00 1.02 (0.76–1.37) 1.11 (0.74–1.64) [0.34]	Sex, education level, alcohol consumption, smoking, age
Gaudet et al. (2015) Pooled analysis of 20 cohorts Follow-up varied by cohort	1 941 300 Men and women Incidence	Oral cavity/pharynx NOS ICD-10: C02.8, 02.9, 05.8, 05.9, 14.0, 14.2, 14.8 ICD-9: 141.8, 141.9, 145.5, 149.0, 149.1, 149.8, 149.9	BMI per 5 kg/m ² [<i>P</i> _{trend}] WC per 5 cm [<i>P</i> _{trend}]	314 total	1.36 (1.11–1.66) [0.003] 1.07 (0.95–1.21) [0.26]	Age, sex, genetic ancestry, cohort, education level, alcohol consumption, smoking
<i>Salivary gland cancer</i>						
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence	Salivary gland ICD-9: 142	Obesity Non-obese Obese Non-obese Obese	White men: 836 60 Black men: 158 10	1.00 1.24 (0.95–1.62) 1.00 1.38 (0.73–2.62)	Age, calendar year Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0
<i>Cancers of the head and neck or upper aerodigestive tract</i>						
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence	Head and neck ICD-9: 140–149	Obesity Non-obese Obese Non-obese Obese	White men: 22 841 957 Black men: 5281 80	1.00 0.69 (0.64–0.73) 1.00 0.31 (0.25–0.39)	Age, calendar year Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0

Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments			
Gaudet et al. (2012) Cancer Prevention Study II Nutrition Cohort USA 1992–2007	150 262 Men and women Incidence	Head and neck	BMI						
			< 22.5	58	1.05 (0.75–1.47)	Sex, education level, alcohol consumption, smoking, age			
			22.5–24.9	85	1.00				
			25–29.9	150	1.02 (0.78–1.34)				
≥ 30	47	1.06 (0.74–1.52)							
			[<i>P</i> _{trend}]		[0.90]				
Gaudet et al. (2012) Cancer Prevention Study II 1982–2008	1 074 914 Men and women Mortality	Head and neck	BMI						
			< 22.5	396	1.28 (1.11–1.47)	Sex, race, education level, alcohol consumption, smoking, age			
			22.5–24.9	404	1.00				
			25–29.9	475	0.76 (0.67–0.87)				
≥ 30	108	0.78 (0.63–0.97)							
			[<i>P</i> _{trend}]		[3.0 × 10 ⁻¹⁰]				
Hashibe et al. (2013) PLCO USA 1992–2010	101 182 Men and women Incidence	Head and neck ICD-10: C00.3– C00.9, C02.0–C02.3, C03.0, C03.1, C03.9, C04.0, C04.1, C04.8, C04.9, C05.0, C06.0– C06.2, C06.8, C06.9, C01.9, C02.4, C05.1, C05.2, C09.0, C09.1, C09.8, C09.9, C10.0– C10.4, C10.8, C10.9, C12.9, C13.0–C13.2, C13.8, C13.9, C02.8, C02.9, C05.8, C05.9, C14.0, C14.2, C14.8, C32.0–C32.3, C32.8– C32.9	BMI at age 20 yr						
			< 18.5	9	0.87 (0.44–1.71)	Age, sex, race, education level, frequency of alcohol consumption, pack-years of tobacco smoking			
			18.5–24.9	133	1.00				
			25.0–29.0	32	1.00 (0.67–1.48)				
			≥ 30.0	0	–				
							[<i>P</i> _{trend}]	[0.47]	
			BMI at age 50 yr						
			< 18.5	2	2.22 (0.54–9.10)				
			18.5–24.9	76	1.00				
			25.0–29.0	73	0.78 (0.56–1.09)				
≥ 30.0	22	0.79 (0.49–1.29)							
			[<i>P</i> _{trend}]	[0.14]					
Current BMI									
< 18.5	1	1.23 (0.17–8.93)							
18.5–24.9	60	1.00							
25.0–29.0	77	0.78 (0.55–1.10)							
≥ 30.0	35	0.72 (0.47–1.10)							
			[<i>P</i> _{trend}]	[0.0995]					

Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments
Hashibe et al. (2013) (cont.)			BMI change (%) from age 50 yr			
			> 10% loss	8	1.05 (0.49–2.25)	
			10% loss to < 10% gain	126	1.00	
			≥ 10% gain	38	0.94 (0.64–1.36)	
			[<i>P</i> _{trend}]		[0.6965]	
			BMI change (%) from age 20 yr			
			> 10% loss	3	0.61 (0.15–2.52)	
			10% loss to < 10% gain	49	1.00	
			≥ 10% gain	121	0.77 (0.55–1.07)	
			[<i>P</i> _{trend}]		[0.24]	
Etemadi et al. (2014) NIH-AARP cohort USA 1995–2006	218 854 Men and women Incidence	Squamous head and neck cancer ICD-10: C32.0– C32.9, C00.1–C06.9, C09.0–C09.9, C10.0– C10.9, C12.9, C13.0– C13.9, C14.0	BMI			
			< 18.5	8	1.70 (0.84–3.46)	Age, sex, marital status, cigarette smoking, education level, ethnicity, alcohol consumption, physical activity, fruit and vegetable intake
			18.5– < 25	249	1.00	
			25– < 30	272	0.88 (0.73–1.04)	
			≥ 30	101	0.85 (0.67–1.08)	
			[<i>P</i> _{trend}]		[0.07]	
			WC, quartiles			
			Q1	153	1.00	
			Q2	125	1.00 (0.78–1.28)	
			Q3	193	1.25 (0.98–1.59)	
Q4	159	1.42 (1.04–1.93)				
[<i>P</i> _{trend}]		[0.01]				
Gaudet et al. (2015) Pooled analysis of 20 cohorts Follow-up varied by cohort	1 941 300 Men and women Incidence	Head and neck	BMI			
			15.0– < 21	354	1.28 (1.11–1.46)	Age, sex, genetic ancestry, cohort, education level, alcohol consumption, smoking
			21– < 23	509	1.00	
			23– < 25	704	0.87 (0.78–0.98)	
			25– < 30	1,586	0.89 (0.81–0.99)	
			≥ 30	607	0.85 (0.76–0.96)	
			per 5 kg/m ²		0.94 (0.90–0.98)	
[<i>P</i> _{trend}]		[0.003]	In interaction with smoking variables, BMI positively associated in never-smokers and inversely associated in current smokers (null association in former smokers)			

Table 2.2.22a Cohort studies of measures of body fatness and cancers of the head and neck

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates Comments
Gaudet et al. (2015) (cont.)			WC (cm), quartiles (sex-specific) Men: < 90 90– < 100 100– < 110 ≥ 110 per 5 cm [<i>P</i> _{trend}] per 5 cm controlling for BMI [<i>P</i> _{trend}] Women: < 70 70– < 80 80– < 90 ≥ 90	484 612 515 320	1.00 0.82 (0.72–0.93) 1.01 (0.89–1.16) 1.08 (0.93–1.25) 1.02 (1.00–1.04) [0.10] 1.04 (1.03–1.05) [< 0.0001]	
Meyer et al. (2015) Swiss cohort study Switzerland 1977–2008	35 703 Men and women Mortality	Upper aerodigestive tract ICD-8: 140–150, 161 ICD-10: C00, C10– C15, C32	BMI < 25 25–29.9 ≥ 30	125 total	1.00 0.71 (0.48–1.05) 0.78 (0.42–1.43)	Sex, age, survey, alcohol consumption, physical activity, marital status, years of education, nationality, diet [Discrepancy in the list of organs considered between ICD-8 and ICD-10]

BMI, body mass index (in kg/m²); CI, confidence interval; ICD, International Classification of Diseases; NIH-AARP, National Institutes of Health–AARP Diet and Health Study; NOS, not otherwise specified; PLCO, Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial; WC, waist circumference; yr, year or years

Table 2.2.22b Case-control studies of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for cofounding
Bosetti et al. (2000) Italy and Switzerland 1984–1997	Women: 195 Women: 1113 Hospital	Oral cavity and pharynx	Current BMI ≥ 26.30 22.95–26.30 < 22.95	54 57 83	1.00 0.99 (0.64–1.53) 1.50 (0.97–2.33)	Education level, tobacco use, alcohol consumption
Rajkumar et al. (2003) Southern India 1996–1999	591 (women: 282) 582 (women: 290) Hospital	Oral cavity	BMI 2 yr before interview < 18.3 18.3–21.7 ≥ 21.8 [<i>P</i> _{trend}]	205 132 83	1.00 0.39 (0.24–0.63) 0.22 (0.13–0.36) [< 0.001]	Sex, age, centre, education level; chewing, smoking, and drinking habits
Rodriguez et al. (2004) Italy and Switzerland 1984–1997	137 (men: 113; women: 24) 298 (men: 226; women: 72) Hospital	Oral cavity and pharynx	Current BMI < 24.22 24.22–26.72 ≥ 26.73 [<i>P</i> _{trend}]	78 37 22	1.00 0.47 (0.24–0.88) 0.28 (0.14–0.56) [0.0003]	Sex, age, study centre, education level, marital status, tobacco use, alcohol consumption, coffee consumption
Garavello et al. (2006) Italy 1992–2000	460 (men: 415; women: 45) 1088 (men: 863; women: 225) Hospital	Larynx	BMI (quintiles) in the 2 yr before cancer diagnosis All: Q5 Q4 Q3 Q2 Q1 [<i>P</i> _{trend}] Men: ≥ 28.95 26.87– < 28.95 25.18– < 26.87 23.38– < 25.18 < 23.38 [<i>P</i> _{trend}]	79 85 87 85 123 75 77 76 80 106	1.00 1.22 (0.80–1.88) 1.15 (0.75–1.78) 1.15 (0.74–1.78) 1.66 (1.08–2.57) [0.051] 1.00 1.06 (0.68–1.66) 1.00 (0.64–1.57) 1.10 (0.70–1.74) 1.47 (0.93–2.33) [0.123]	Age, centre, alcohol consumption, tobacco smoking, physical activity, fruit and vegetable intake, non-alcohol energy intake

Table 2.2.22b Case-control studies of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for cofounding
Garavello et al. (2006) (cont.)			Women: ≥ 28.54 26.18– < 28.54 24.14– < 26.18 22.10– < 24.14 < 22.10 [<i>P</i> _{trend}]	4 8 11 5 17	1.00 5.84 (0.84–40.64) 7.87 (1.20–51.63) 1.65 (0.18–15.11) 8.11 (1.38–47.66) [0.141]	
Kreimer et al. (2006) Australia, Canada, Cuba, India, Italy, Northern Ireland, Poland, Spain, and Sudan (IARC study) 1996–1999	1670 1732 Hospital	Oral cavity and oropharyngeal squamous cell carcinoma	BMI, approximate country-specific tertiles in 2-yr period before questionnaire Overall: High Medium Low [<i>P</i> _{trend}] Never tobacco use: High Medium Low [<i>P</i> _{trend}] Ever tobacco use: High Medium Low [<i>P</i> _{trend}]	354 454 626	1.00 1.5 (1.2–1.9) 2.8 (2.3–3.5) [< 0.0001] 1.00 1.7 (1.1–2.6) 2.5 (1.6–4.0) [0.0001] 1.00 1.5 (1.2–1.9) 2.9 (2.3–3.8) [< 0.0001]	Age, sex, county, education level, tobacco smoking, tobacco chewing, alcohol consumption
Peters et al. (2008) USA 1999–2003	504 717 Population		BMI 5 yr before enrolment < 18.5 ≥ 18.5– < 25 ≥ 25– < 30 ≥ 30	65 172 181 86	5.81 (3.20–10.56) 1.00 0.89 (0.66–1.20) 0.65 (0.46–0.92)	Age, race, sex, tobacco use, alcohol consumption

Table 2.2.22b Case-control studies of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for cofounding
Radoi et al. (2013) France, ICARE study 2001–2007	689 3481 Population	Oral cavity	BMI at interview			Age, sex, area of residence, education level, tobacco smoking, alcohol consumption
			All:			
			< 18.5	99	6.25 (3.74–10.45)	
			18.5–24.9	399	1.00	
			25–29.9	150	0.32 (0.25–0.41)	
			≥ 30	28	0.13 (0.08–0.20)	
			Men:			
			< 18.5	75	14.5 (6.37–33.1)	
			18.5–24.9	327	1.00	
			25–29.9	120	0.28 (0.21–0.38)	
			≥ 30	25	0.12 (0.07–0.21)	
			Women:			
			< 18.5	24	3.02 (1.24–7.34)	
			18.5–24.9	72	1.00	
			25–29.9	30	0.61 (0.33–1.14)	
			≥ 30	3	0.08 (0.01–0.36)	
			BMI 2 yr before interview			
			All:			
			< 18.5	28	1.67 (0.82–3.39)	
			18.5–24.9	380	1.00	
			25–29.9	188	0.53 (0.42–0.68)	
			≥ 30	65	0.38 (0.26–0.53)	
			Men:			
			< 18.5	18	2.81 (1.07–7.37)	
			18.5–24.9	314	1.00	
			25–29.9	153	0.48 (0.36–0.62)	
			≥ 30	50	0.30 (0.20–0.45)	
			Women:			
			< 18.5	10	0.91 (0.25–3.32)	
			18.5–24.9	66	1.00	
			25–29.9	35	0.87 (0.46–1.64)	
			≥ 30	15	0.93 (0.42–2.04)	

Table 2.2.22b Case-control studies of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for cofounding
Radoi et al. (2013) (cont.)			BMI at age 30 yr			
			All:			
			< 18.5	29	1.00 (0.56–1.79)	
			18.5–24.9	495	1.00	
			25–29.9	90	0.60 (0.44–0.80)	
			≥ 30	13	0.46 (0.23–0.89)	
			Men:			
			< 18.5	14	0.97 (0.42–2.23)	
			18.5–24.9	410	1.00	
			25–29.9	73	0.51 (0.37–0.70)	
			≥ 30	11	0.42 (0.20–0.89)	
			Women:			
			< 18.5	15	1.34 (0.55–3.27)	
			18.5–24.9	85	1.00	
			25–29.9	17	2.10 (0.94–4.67)	
			≥ 30	2	0.71 (0.14–3.62)	
Petrick et al. (2014) USA, CHANCE study 2002–2006	1289 (African American: 330) 1361 (African American: 261) Population	Head and neck	BMI 1 yr before diagnosis			Age, sex, education level, lifetime alcohol consumption, duration of cigarette smoking
			White:			
			< 18.5	23	1.48 (0.60–3.65)	
			18.5–24.9	302	1.00	
			25.0–29.9	320	1.05 (0.82–1.35)	
			≥ 30	254	1.34 (1.02–1.76)	
			[<i>P</i> _{trend}]		[0.02]	
			African American:			
			< 18.5	19	3.91 (0.72–21.17)	
			18.5–24.9	150	1.00	
			25.0–29.9	81	0.51 (0.32–0.83)	
			≥ 30	57	0.47 (0.28–0.79)	
			[<i>P</i> _{trend}]		[0.01]	

Table 2.2.22b Case-control studies of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for cofounding
Petrick et al. (2014) (cont.)	1289 (African American: 330) 1361 (African American: 261) Population		Never tobacco smokers:			
			White:			
			< 18.5	0	–	
			18.5–24.9	32	1.00	
			25.0–29.9	53	1.36 (0.83–2.25)	
			≥ 30	68	2.28 (1.38–3.76)	
			[<i>P</i> _{trend}]		[0.002]	
			African American:			
			< 18.5	1	2.84 (0.18–45.4)	
			18.5–24.9	2	1.00	
			25.0–29.9	6	0.69 (0.35–1.37)	
			≥ 30	4	0.85 (0.42–1.70)	
			[<i>P</i> _{trend}]		[0.4]	
			Ever tobacco smokers:			
			White:			
			< 18.5	23	1.42 (0.56–3.61)	
			18.5–24.9	270	1.00	
			25.0–29.9	267	0.98 (0.74–1.30)	
			≥ 30	186	1.10 (0.81–1.50)	
			[<i>P</i> _{trend}]		[0.5]	
			African American:			
			< 18.5	18	5.06 (0.61–41.8)	
			18.5–24.9	148	1.00	
			25.0–29.9	75	0.50 (0.30–0.82)	
			≥ 30	53	0.41 (0.24–0.70)	
			[<i>P</i> _{trend}]		[0.003]	

Table 2.2.22b Case-control studies of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for cofounding
Tan et al. (2015) USA 1999–2011	959 (oral cavity: 353; pharynx: 440; larynx: 153) 1208 Population	Head and neck squamous cell carcinoma	BMI 5 yr before interview All: 18.5–25 25–30 ≥ 30 [<i>P</i> _{trend}]	325 421 213	1.00 1.01 (0.79–1.29) 0.79 (0.60–1.04) [0.08]	HPV status, age, sex, race, education level, smoking status, alcohol consumption Also reported analyses stratified by both HPV seropositivity and smoking status (ever/never)
			High-risk HPV seropositive: 18.5–25 25–30 ≥ 30 [<i>P</i> _{trend}]	154 240 131	1.00 1.15 (0.88–1.49) 0.91 (0.68–1.21) [0.46]	
			High-risk HPV seronegative: 18.5–25 25–30 ≥ 30 [<i>P</i> _{trend}]	119 124 53	1.00 0.78 (0.57–1.08) 0.48 (0.32–0.70) [< 0.0001]	

BMI, body mass index (in kg/m²); CI, confidence interval; HPV, human papillomavirus; IARC, International Agency for Research on Cancer; ICD, International Classification of Diseases; yr, year or years

Table 2.2.22c Meta-analyses of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Stratification (smoking status or subsite)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding Comments		
Gaudet et al. (2010) INHANCE consortium	Pooled data from 17 case–control studies 12 716 (women: 2759; men: 9957) 17 438 (women: 5124; men: 12 314) Hospital: 9844/13 378 Population: 2872/4060	All	BMI at reference date					
			< 18.5	918	2.13 (1.75–2.58)	Age, sex, race, education level, study centres, cigarette smoking, lifetime duration of pipe use, cigar use, alcoholic drinks per day		
			18.5–24.9	5749	1.00			
			25.0–29.9	2855	0.52 (0.44–0.60)			
			≥ 30.0	1011	0.43 (0.33–0.57)			
			[<i>P</i> _{trend}]		[< 10 ^{−6}]			
			Never-smokers	< 18.5	40		3.13 (0.73–13.4)	Similar results with BMI 2–5 yr before reference date
				18.5–24.9	183		1.00	
				25.0–29.9	145		0.94 (0.49–1.80)	
				≥ 30.0	113		0.95 (0.47–1.91)	
			[<i>P</i> _{trend}]				[0.49]	
			Ever-smokers	< 18.5	167		2.01 (1.60–2.52)	
18.5–24.9	3287	1.00						
25.0–29.9	3222	0.50 (0.45–0.56)						
≥ 30.0	1142	0.38 (0.30–0.49)						
[<i>P</i> _{trend}]			[< 10 ^{−6}]					
Lubin et al. (2010) INHANCE consortium	Pooled data from 15 case–control studies 6333 (analysis of never-smokers and current smokers) 8452 (analysis of never-drinkers and alcohol consumers) ≥ 8000	Oral cavity	BMI			Study/centre, education level, age, sex		
			< 18.5	307	2.58 (2.0–3.4)			
			18.5–24.9	1352	1.00			
			25.0–29.9	651	0.52 (0.5–0.6)			
			30.0–34.9	187	0.50 (0.4–0.6)			
			35.0–39.9	42	0.58 (0.4–0.9)			
			≥ 40	24	0.76 (0.4–1.3)			
			Pharynx	< 18.5	205		2.68 (2.0–3.6)	
				18.5–24.9	1612		1.00	
		25.0–29.9		938	0.57 (0.5–0.6)			
		30.0–34.9		259	0.52 (0.4–0.6)			
		35.0–39.9		50	0.46 (0.3–0.7)			
		≥ 40		25	0.44 (0.3–0.7)			
		Larynx	< 18.5	80	1.69 (1.1–2.5)			
			18.5–24.9	1011	1.00			
			25.0–29.9	666	0.63 (0.5–0.7)			
			30.0–34.9	164	0.58 (0.5–0.7)			
			35.0–39.9	39	0.66 (0.4–1.1)			
≥ 40	12		0.60 (0.3–1.3)					

Table 2.2.22c Meta-analyses of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Stratification (smoking status or subsite)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding Comments
Lubin et al. (2011) INHANCE consortium	Pooled data from 15 case-control studies Oral cavity: 2441 (women: 925; men: 1516) Oropharynx: 2297 (women: 564; men: 1733) Hypopharynx: 508 (women: 96; men: 412) Larynx: 1740 (women: 237; men: 1503) 7604/13 829	Oral cavity	BMI			
			Women:			
			< 18.5		2.54 (1.7–3.8)	
			18.5–24.9		1.00	
			25.0–29.9		0.67 (0.5–0.9)	
			30.0–34.9		0.75 (0.5–1.1)	
		≥ 35.0		0.92 (0.5–1.6)		
		[<i>P</i> _{trend}]		[< 0.01]		
		Men:				
		< 18.5		3.33 (1.9–5.7)		
		18.5–24.9		1.00		
		25.0–29.9		0.46 (0.4–0.6)		
30.0–34.9		0.40 (0.3–0.6)				
≥ 35.0		0.65 (0.4–1.1)				
[<i>P</i> _{trend}]		[< 0.01]				
Oropharynx			Women:			
			< 18.5		3.09 (1.8–5.2)	
			18.5–24.9		1.00	
			25.0–29.9		0.63 (0.5–0.9)	
			30.0–34.9		0.60 (0.4–0.9)	
			≥ 35.0		0.35 (0.2–0.7)	
[<i>P</i> _{trend}]		[< 0.01]				
Men:			< 18.5		2.38 (1.4–4.2)	
			18.5–24.9		1.00	
			25.0–29.9		0.25 (0.1–0.6)	
			30.0–34.9		0.24 (0.1–0.8)	
			≥ 35.0		–	
			[<i>P</i> _{trend}]		[< 0.01]	
Larynx			Women:			
			< 18.5		1.79 (0.7–4.9)	
			18.5–24.9		1.00	
			25.0–29.9		0.61 (0.4–1.0)	
			30.0–34.9		0.26 (0.1–0.6)	
			≥ 35.0		0.27 (0.1–0.8)	
[<i>P</i> _{trend}]		[< 0.01]				

Table 2.2.22c Meta-analyses of measures of body fatness and cancers of the head and neck

Reference Study location Period	Total number of cases Total number of controls Source of controls	Stratification (smoking status or subsite)	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding Comments
Lubin et al. (2011) (cont.)			Men: < 18.5 18.5–24.9 25.0–29.9 30.0–34.9 ≥ 35.0 [<i>P</i> _{trend}]		1.77 (1.0–3.3) 1.00 0.70 (0.6–0.8) 0.65 (0.5–0.9) 0.77 (0.4–1.4) [< 0.01]	

BMI, body mass index (in kg/m²); CI, confidence interval; yr, year or years

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