

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

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<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

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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 Black men: 2612 67	1.00 0.77 (0.71–0.85) 1.00 0.51 (0.40–0.65)	Age, calendar year Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0	
			Non-obese Obese				
			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]		

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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

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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

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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]					

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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			Age, sex, genetic ancestry, cohort, education level, alcohol consumption, smoking
			15.0– < 21	354	1.28 (1.11–1.46)	
			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)			

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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

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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

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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)	

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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

References

- Andreotti G, Hou L, Beane Freeman LE, Mahajan R, Koutros S, Coble J, et al. (2010). Body mass index, agricultural pesticide use, and cancer incidence in the Agricultural Health Study cohort. *Cancer Causes Control*. 21(11):1759–75. <http://dx.doi.org/10.1007/s10552-010-9603-9> PMID:20730623
- 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. [http://dx.doi.org/10.1016/S0140-6736\(14\)60892-8](http://dx.doi.org/10.1016/S0140-6736(14)60892-8) PMID:25129328
- Bosetti C, Negri E, Franceschi S, Conti E, Levi F, Tomei F, et al. (2000). Risk factors for oral and pharyngeal cancer in women: a study from Italy and Switzerland. *Br J Cancer*. 82(1):204–7. PMID:10638990
- Etemadi A, O’Doherty MG, Freedman ND, Hollenbeck AR, Dawsey SM, Abnet CC (2014). A prospective cohort study of body size and risk of head and neck cancers in the NIH-AARP Diet and Health Study. *Cancer Epidemiol Biomarkers Prev*. 23(11):2422–9. <http://dx.doi.org/10.1158/1055-9965.EPI-14-0709-T> PMID:25172872
- Garavello W, Randi G, Bosetti C, Dal Maso L, Negri E, Barzan L, et al. (2006). Body size and laryngeal cancer risk. *Ann Oncol*. 17(9):1459–63. <http://dx.doi.org/10.1093/annonc/mdl166> PMID:16873426
- Gaudet MM, Kitahara CM, Newton CC, Bernstein L, Reynolds P, Weiderpass E, et al. (2015). Anthropometry and head and neck cancer: a pooled analysis of cohort data. *Int J Epidemiol*. 44(2):673–81. <http://dx.doi.org/10.1093/ije/dyv059> PMID:26050257
- Gaudet MM, Olshan AF, Chuang SC, Berthiller J, Zhang ZF, Lissowska J, et al. (2010). Body mass index and risk of head and neck cancer in a pooled analysis of case-control studies in the International Head and Neck Cancer Epidemiology (INHANCE) Consortium. *Int J Epidemiol*. 39(4):1091–102. <http://dx.doi.org/10.1093/ije/dyp380> PMID:20123951
- Gaudet MM, Patel AV, Sun J, Hildebrand JS, McCullough ML, Chen AY, et al. (2012). Prospective studies of body mass index with head and neck cancer incidence and mortality. *Cancer Epidemiol Biomarkers Prev*. 21(3):497–503. <http://dx.doi.org/10.1158/1055-9965.EPI-11-0935> PMID:22219317
- Hashibe M, Hunt J, Wei M, Buys S, Gren L, Lee YC (2013). Tobacco, alcohol, body mass index, physical activity, and the risk of head and neck cancer in the Prostate, Lung, Colorectal, and Ovarian (PLCO) cohort. *Head Neck*. 35(7):914–22. <http://dx.doi.org/10.1002/hed.23052> PMID:22711227
- Kreimer AR, Randi G, Herrero R, Castellsagué X, La Vecchia C, Franceschi S; IARC Multicenter Oral Cancer Study Group (2006). Diet and body mass, and oral and oropharyngeal squamous cell carcinomas: analysis from the IARC multinational case-control study. *Int J Cancer*. 118(9):2293–7. <http://dx.doi.org/10.1002/ijc.21577> PMID:16331628
- Lubin JH, Gaudet MM, Olshan AF, Kelsey K, Boffetta P, Brennan P, et al. (2010). Body mass index, cigarette smoking, and alcohol consumption and cancers of the oral cavity, pharynx, and larynx: modeling odds ratios in pooled case-control data. *Am J Epidemiol*. 171(12):1250–61. <http://dx.doi.org/10.1093/aje/kwq088> PMID:20494999
- Lubin JH, Muscat J, Gaudet MM, Olshan AF, Curado MP, Dal Maso L, et al. (2011). An examination of male and female odds ratios by BMI, cigarette smoking, and alcohol consumption for cancers of the oral cavity, pharynx, and larynx in pooled data from 15 case-control studies. *Cancer Causes Control*. 22(9):1217–31. <http://dx.doi.org/10.1007/s10552-011-9792-x> PMID:21744095
- Meyer J, Rohrmann S, Bopp M, Faeh D; Swiss National Cohort Study Group (2015). Impact of smoking and excess body weight on overall and site-specific cancer mortality risk. *Cancer Epidemiol Biomarkers Prev*. 24(10):1516–22. <http://dx.doi.org/10.1158/1055-9965.EPI-15-0415> PMID:26215293

- Parr CL, Batty GD, Lam TH, Barzi F, Fang X, Ho SC, et al.; Asia-Pacific Cohort Studies Collaboration (2010). Body-mass index and cancer mortality in the Asia-Pacific Cohort Studies Collaboration: pooled analyses of 424,519 participants. *Lancet Oncol.* 11(8):741–52. [http://dx.doi.org/10.1016/S1470-2045\(10\)70141-8](http://dx.doi.org/10.1016/S1470-2045(10)70141-8) PMID:20594911
- Peters ES, Lockett BG, Applebaum KM, Marsit CJ, McClean MD, Kelsey KT (2008). Dairy products, leanness, and head and neck squamous cell carcinoma. *Head Neck.* 30(9):1193–205. <http://dx.doi.org/10.1002/hed.20846> PMID:18642285
- Petrick JL, Gaudet MM, Weissler MC, Funkhouser WK, Olshan AF (2014). Body mass index and risk of head and neck cancer by race: the Carolina Head and Neck Cancer Epidemiology Study. *Ann Epidemiol.* 24(2):160–164.e1. <http://dx.doi.org/10.1016/j.annepidem.2013.11.004> PMID:24342030
- Radoï L, Paget-Bailly S, Cyr D, Papadopoulos A, Guida F, Tarnaud C, et al. (2013). Body mass index, body mass change, and risk of oral cavity cancer: results of a large population-based case-control study, the ICARE study. *Cancer Causes Control.* 24(7):1437–48. <http://dx.doi.org/10.1007/s10552-013-0223-z> PMID:23677332
- Rajkumar T, Sridhar H, Balaram P, Vaccarella S, Gajalakshmi V, Nandakumar A, et al. (2003). Oral cancer in Southern India: the influence of body size, diet, infections and sexual practices. *Eur J Cancer Prev.* 12(2):135–43. <http://dx.doi.org/10.1097/00008469-200304000-00007> PMID:12671537
- Rodriguez T, Altieri A, Chatenoud L, Gallus S, Bosetti C, Negri E, et al. (2004). Risk factors for oral and pharyngeal cancer in young adults. *Oral Oncol.* 40(2):207–13. <http://dx.doi.org/10.1016/j.oraloncology.2003.08.014> PMID:14693246
- 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. <http://dx.doi.org/10.1023/B:CACO.0000016573.79453.ba> PMID:14970733
- Tan X, Nelson HH, Langevin SM, McClean M, Marsit CJ, Waterboer T, et al. (2015). Obesity and head and neck cancer risk and survival by human papillomavirus serology. *Cancer Causes Control.* 26(1):111–9. <http://dx.doi.org/10.1007/s10552-014-0490-3> PMID:25398682