

ABSENCE OF EXCESS BODY FATNESS

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2.2.3 Cancer of the stomach

In 2012, gastric cancer, or cancer of the stomach, was the fifth most commonly diagnosed cancer worldwide, with heterogeneous geographical distribution ([Jemal et al., 2014](#)). Gastric cancer can generally be classified into two subsites: cancer of the gastric cardia, which arises from the area of the stomach adjoining the gastro-oesophageal junction, and non-cardia gastric cancer, which develops in the distal stomach and represents about 73% of all gastric cancer cases globally ([Colquhoun et al., 2015](#)). Several risk factors for gastric cardia and non-cardia cancer have been identified. For example, infection with *Helicobacter pylori* has been strongly associated with non-cardia gastric cancer, whereas diets rich in smoked foods, salted foods (especially fish), or pickled foods, as well as cigarette smoking, appear to increase the risk of both types of gastric cancer ([Kamangar et al., 2006](#); [IARC, 2012](#)).

In 2001, the *IARC Handbook on weight control and physical activity* ([IARC, 2002](#)) reviewed the studies of cancer of the gastric cardia together with studies of oesophageal adenocarcinoma, but did not provide a separate evaluation for stomach cancer (cardia or non-cardia). Since then, numerous individual and pooled cohort studies and meta-analyses, as well as several case-control studies of anthropometric measures and risk of stomach cancer have been published. Results from studies that examined this association for gastric cancer not otherwise specified (NOS) and separately for gastric cardia and non-cardia cancers are summarized here and in [Tables 2.2.3a](#), [2.2.3b](#), and [2.2.3c](#). Studies that had fewer than 75 incident cases or that overlapped with a more recent study, as well as those that considered gastric cardia and oesophageal cancers together, were excluded.

(a) Cohort studies

(i) Gastric cancer NOS

Since 2000, at least 20 individual cohort studies ([Table 2.2.3a](#)) and six meta-analyses or pooled analyses ([Table 2.2.3c](#)) of prospective studies have examined associations of baseline BMI with gastric cancer incidence and/or mortality. Most of the individual prospective studies showed no associations with gastric cancer incidence or mortality ([Table 2.2.3a](#)). A few studies found inconsistent evidence of either positive or negative associations ([Calle et al., 2003](#); [Samanic et al., 2006](#); [Jee et al., 2008](#); [Persson et al., 2008](#); [Camargo et al., 2014](#)).

Although three pooled analyses and one meta-analysis also showed no association between high BMI and incidence of gastric cancer ([Lindkvist et al., 2013](#)) or incidence and/or mortality ([Renehan et al., 2008](#); [Whitlock et al., 2009](#); [Parr et al., 2010](#)), others were suggestive of a positive association ([Yang et al., 2009](#); [Chen et al., 2013](#); [Lin et al., 2014](#)). In the most recent meta-analysis of 12 prospective studies of gastric cancer incidence and mortality combined and more than 41 791 gastric cancer cases, strong associations with overweight and obesity were reported in men only, but there was no evidence of heterogeneity of results according to sex ([Chen et al., 2013](#)). The same study did not show heterogeneity in results between Asian and non-Asian populations.

No associations of weight or BMI in early adulthood, usually defined as age 18–21 years, with gastric cancer incidence or mortality were found in three studies ([Fujino et al., 2007](#); [Merry et al., 2007](#); [Tanaka et al., 2007](#)), or of BMI change during adulthood in relation to incidence of gastric cancer ([Merry et al., 2007](#); [Rapp et al., 2008](#)). No prospective studies of waist circumference and total gastric cancer were identified.

(ii) Cancer of the gastric cardia

Most individual prospective studies of the association between baseline BMI (or weight) and cardia gastric cancer incidence (or incidence and mortality) showed a positive association (see [Table 2.2.3a](#)), except for four studies ([Tran et al., 2005](#); [Samanic et al., 2006](#); [Corley et al., 2008](#); [Steffen et al., 2015](#)). In the large meta-analysis by Chen et al., overweight was associated with a 21% higher risk (based on six studies) and obesity was associated with an 82% higher risk (based on seven studies) compared with normal BMI (18.5–24.9 kg/m²) ([Chen et al., 2013](#)). These findings were similar to those reported in an earlier meta-analysis of three prospective studies ([Yang et al., 2009](#)).

Associations of BMI in early adulthood and adult BMI change with incidence of cardia gastric cancer were examined in only one study of mortality ([Merry et al., 2007](#)). In that study, BMI at age 20 years was not associated with risk, whereas increasing BMI from age 20 years to baseline showed a positive association ($P_{\text{trend}} = 0.02$).

Although one study showed no association between sagittal abdominal diameter and risk of gastric cardia cancer ([Corley et al., 2008](#)), in the NIH-AARP cohort a 2.2-fold higher risk for the fourth versus the first quartile of waist circumference was reported, with a significant trend ([O’Doherty et al., 2012](#)). A similar positive trend of waist circumference and gastric cardia cancer risk (incidence and mortality) was also found in the EPIC study ([Steffen et al., 2015](#)).

(iii) Non-cardia gastric cancer

Findings from cohort studies and meta-analyses of excess body weight at baseline in relation to incidence of non-cardia gastric cancer are inconsistent. Neither BMI nor weight was associated with risk in most individual prospective studies (see [Table 2.2.3a](#)). Similarly, several meta-analyses did not show an association between BMI and risk either ([Yang et al., 2009](#);

[Chen et al., 2013](#); [Lin et al., 2014](#)). However, in the Linxian General Population Trial, a significant inverse association was reported with a relative risk of 0.68 for BMI ≥ 23 kg/m² versus BMI < 20 kg/m² ([Tran et al., 2005](#)), and a significant inverse association was also reported in a Swedish cohort study ($P_{\text{trend}} < 0.01$) ([Samanic et al., 2006](#)). Conversely, one individual study suggested a positive association of BMI and/or weight and risk of non-cardia gastric cancer ([O’Doherty et al., 2012](#)).

No associations were reported in the only study of BMI in early adulthood and adult BMI change in relation to incidence of non-cardia gastric cancer ([Merry et al., 2007](#)), or in the three studies that examined waist circumference and risk of non-cardia gastric cancer ([MacInnis et al., 2006](#); [O’Doherty et al., 2012](#); [Steffen et al., 2015](#)).

(b) Case-control studies

See [Table 2.2.3b](#).

There were a total of 11 independent reports from case-control studies on the association of BMI with risk of gastric cancer, in China, Europe, Japan, the Republic of Korea, the USA, and Venezuela. With the exception of one hospital-based study ([Kim et al., 2015](#)), in which BMI was measured at the time of initial endoscopic diagnosis, BMI was assessed through self-reports of height and body weight, referring to either a recent period (mostly 1 year) before disease diagnosis or a period in the more distant past (e.g. at age 18 years or 20 years), or both. In addition to standard adjustments for age and sex, studies were reported with variable adjustments for further confounding factors such as smoking, alcohol consumption, family history of gastric cancer, dietary variables, or *H. pylori* infection.

With regard to gastric cardia cancer, three out of four studies showed a positive association of BMI with risk. Three studies specifically addressing non-cardia cancer showed no association of recent BMI with risk, whereas two studies reported a positive association of risk

with BMI at age 20 years. With regard to overall gastric cancer – without specification by subsite – three studies showed an increase in risk with increasing BMI, one showed a decrease in risk, and two showed no significant association.

Table 2.2.3a Cohort studies of measures of body fatness and cancer of the stomach

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
<i>Stomach not otherwise specified</i>							
Calle et al. (2003) Cancer Prevention Study II (CPS II) USA 1982–1998	404 576 Men Mortality	Stomach ICD-9: 151.0–151.9	BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 [<i>P</i> _{trend}]	388 455 84 18	1.00 1.01 (0.88–1.16) 1.20 (0.94–1.52) 1.94 (1.21–3.13) [0.03]	Age, education level, smoking, physical activity, alcohol consumption, marital status, race, aspirin use, consumption of fat and vegetables; for women, also adjusted for HRT use	
	495 477 Women Mortality		BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 [<i>P</i> _{trend}]	304 134 57 13	1.00 0.89 (0.72–1.09) 1.30 (0.97–1.74) 1.08 (0.61–1.89) [0.46]		
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence	Stomach ICD-9: 151	Obesity Non-obese Obese Non-obese Obese	 White men: 4989 309 Black men: 2089 99	 1.00 1.07 (0.95–1.20) 1.00 0.98 (0.79–1.20)	Age, calendar year	Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Batty et al. (2005) Whitehall study of London-based male government employees United Kingdom 1967–2002	18 403 Men Mortality	Stomach	BMI 18.5–24.9 25.0–29.9 ≥ 30 [<i>P</i> _{trend}]	100 81 9	1.00 1.05 (0.76–1.44) 1.23 (0.59–2.58) [0.60]	Age, employment grade, physical activity, smoking, marital status, prevalent disease, weight loss in past year, BP medication, height, skinfold thickness, systolic BP, plasma cholesterol, glucose intolerance, diabetes	
Kuriyama et al. (2005) Population-based cohort Japan 1984–1992	12 485 Men Incidence 15 054 Women Incidence	Stomach ICD-9: 151.0–151.9	BMI 18.5–24.9 25.0–27.4 27.5–29.9 ≥ 30 [<i>P</i> _{trend}] BMI 18.5–24.9 25.0–27.4 27.5–29.9 ≥ 30 [<i>P</i> _{trend}]	243 50 14 7 79 26 17 4	1.00 1.01 (0.74–1.37) 0.96 (0.56–1.65) 1.13 (0.53–2.41) [0.91] 1.00 1.19 (0.76–1.86) 1.80 (1.06–3.05) 0.79 (0.29–2.17) [0.25]	Age, smoking, alcohol consumption, diet, type of health insurance; for women, also adjusted for menopausal status, parity, age at menarche, age at first pregnancy	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Lindblad et al. (2005) Case-control study nested in General Practitioner Research Database United Kingdom 1994-2001	11 023 Men and women Incidence	Stomach	BMI < 20 20-24 25-29 ≥ 30 [<i>P</i> _{trend}]	29 217 254 98	1.05 (0.69-1.58) 1.00 1.09 (0.90-1.32) 1.21 (0.94-1.56) [0.21]	Age, sex, calendar year, smoking, alcohol consumption, reflux	
Rapp et al. (2005) VHM&PP (population-based cohort) Austria 1985-2001	67 447 Men Incidence	Stomach ICD-9: 151	BMI 18.5-24.9 25-29.9 ≥ 30 [<i>P</i> _{trend}] BMI 18.5-24.9 25-29.9 30-34.9 ≥ 35 [<i>P</i> _{trend}]	58 75 13 56 36 20 6	1.00 1.04 (0.73-1.47) 0.72 (0.40-1.33) [0.44] 1.00 0.78 (0.51-1.20) 1.28 (0.76-2.15) 1.34 (0.57-3.13) [0.48]	Age, smoking status, occupation Age, smoking status, occupation	
Samanic et al. (2006) Swedish Construction Worker Cohort Sweden 1958-1999	362 552 Men Incidence	Stomach ICD-7: 151	BMI 18.5-24.9 25-29.9 ≥ 30 [<i>P</i> _{trend}]	666 531 84	1.00 0.87 (0.77-0.97) 0.83 (0.66-1.05) [< 0.05]	Attained age, calendar year, smoking	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Fujino et al. (2007)	46 465	Stomach	BMI			Age, study area	
JACC cohort	Men		< 18.5	54	1.00 (0.75–1.32)		
Japan	Mortality		18.5–24	569	1.00		
1988–1997			25–29	89	0.78 (0.62–0.97)		
			≥ 30	7	1.04 (0.49–2.20)		
			Weight (kg)				
			< 55	280	1.00		
			55–62	260	0.88 (0.74–1.04)		
			≥ 63	198	0.83 (0.69–1.01)		
			Weight (kg) at age 20 yr				
			< 55	339	1.00		
			55–60	210	1.04 (0.84–1.30)		
			≥ 61	157	1.17 (0.93–1.48)		
	46 465	Stomach	BMI			Age, study area	
	Women		< 18.5	37	1.44 (1.01–2.05)		
	Mortality		18.5–24	227	1.00		
			25–29	66	0.98 (0.74–1.30)		
			≥ 30	11	1.52 (0.82–2.80)		
			Weight (kg)				
			< 47	156	1.00		
			47–54	84	0.79 (0.60–1.03)		
			≥ 55	118	1.01 (0.78–1.29)		
			Weight (kg) at age 20 yr				
			< 47	167	1.00		
			47–52	72	0.97 (0.70–1.34)		
			≥ 53	95	1.25 (0.92–1.70)		
Máchová et al. (2007)	17 218	Stomach	BMI	222 total		Age, smoking, hypertension, height	Nested case–control study, reporting odds ratios
National Cancer Registry	Men	ICD-10: C16	18.5–24.9		1.00		
Czech Republic	Incidence		25–29.9		1.05 (0.74–1.47)		
1987–2002	20 932		≥ 30		0.92 (0.57–1.50)		
	Women		BMI	156 total		Age, smoking, hypertension, height	
	Incidence		18.5–24.9		1.00		
			25–29.9		0.81 (0.51–1.27)		
			≥ 30		0.97 (0.60–1.57)		

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Merry et al. (2007) Netherlands Cohort Study The Netherlands 1986–1999	4774 Men and women Incidence	Stomach, unspecified location ICD-O-3: C16.6–16.9 Histology: 8140– 8141, 8190–8231, 8260–8263, 8310, 8430, 8480–8490, 8560, 8570–8572	BMI at baseline			Age, sex, smoking, education level, history of gastric ulcer or bleeding	
			< 20	6	0.92 (0.38–2.25)		
			20–24.9	93	1.00		
			25–29.9	67	0.85 (0.61–1.19)		
			≥ 30	7	0.77 (0.35–1.68) [0.33]		
			[P _{trend}]				
			BMI at age 20 yr				
			< 20	26	0.60 (0.37–0.99)		
			20–21.4	49	1.00		
			21.5–22.9	40	0.92 (0.59–1.44)		
			23.0–24.9	26	0.70 (0.42–1.18)		
			≥ 25	12	0.82 (0.42–1.60) [0.72]		
[P _{trend}]							
BMI change, age 20 yr to baseline							
< 0	16	0.85 (0.47–1.55)					
0–3.9	82	1.00					
4–7.9	45	0.85 (0.56–1.27)					
≥ 8	10	0.86 (0.41–1.80) [0.70]					
[P _{trend}]							
Reeves et al. (2007) Million Women Study United Kingdom 1996–2005	1 222 630 Women Incidence and mortality	Stomach ICD-10: C16	BMI			Age, geographical region, SES, reproductive history, smoking status, alcohol consumption, physical activity, menopausal status, time since menopause, HRT use	
			< 22.5	117	1.26 (1.05–1.51)		
			22.5–24.9	121	1.00 (0.84–1.20)		
			25–27.4	111	1.04 (0.86–1.25)		
			27.5–29.9	76	1.10 (0.88–1.38)		
			≥ 30	96	1.04 (0.84–1.27)		
			BMI				
			< 22.5	92	1.47 (1.19–1.81)		
			22.5–24.9	82	1.00 (0.80–1.24)		
			25–27.4	85	1.16 (0.93–1.43)		
27.5–29.9	64	1.34 (1.05–1.71)					
≥ 30	80	1.24 (0.99–1.55)					

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Tanaka et al. (2007) Population cohort from Takayama Japan 1992–2000	13 211 Men Mortality	Stomach ICD-9: 151 ICD-10: C16	BMI at baseline < 20.3 20.3–22.2 > 22.2 [<i>P</i> _{trend}] BMI at age 20 yr < 20.3 20.3–22.2 > 22.2 [<i>P</i> _{trend}]	29 20 16 12 33 41	1.00 0.68 (0.34–1.33) 0.53 (0.24–1.20) [0.12] 1.00 2.53 (1.18–5.43) 1.72 (0.79–3.73) [0.76]	Age, smoking, alcohol consumption, education level, physical activity, marital status	Too few incident cases in women (results not shown)
Lee et al. (2008) Cohort from the National Health Insurance Corporation Republic of Korea 1992–2006	770 556 Men Incidence 423 273 Women Incidence	Stomach Stomach	BMI < 20.0 20.0–22.9 23.0–24.9 25.0–29.9 ≥ 30.0 [<i>P</i> _{trend}] BMI < 20.0 20.0–22.9 23.0–24.9 25.0–29.9 ≥ 30.0 [<i>P</i> _{trend}]	1808 5602 3839 3188 131 524 1314 1035 1132 111	1.04 (0.97–1.13) 1.07 (1.01–1.13) 1.00 1.09 (1.02–1.16) 1.31 (1.05–1.64) [0.50] 0.86 (0.75–1.00) 0.90 (0.80–1.00) 1.00 0.94 (0.84–1.05) 0.84 (0.64–1.11) [0.25]	Age, smoking Age, smoking	
Rapp et al. (2008) VHM&PP (population-based cohort) Austria 1985–2002	28 711 Men Incidence	Stomach ICD-10: C16	BMI change per year < –0.1 –0.1– < 0.1 0.1– < 0.3 ≥ 0.3 [<i>P</i> _{trend}]	11 25 20 10	0.75 (0.36–1.54) 1.00 1.18 (0.65–2.13) 1.22 (0.58–2.59) [0.49]	Age, smoking status, blood glucose, occupational group, baseline BMI	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Rapp et al. (2008) (cont.)	36 938 Women Incidence		BMI change per year < -0.1 -0.1- < 0.1 0.1- < 0.3 ≥ 0.3 [<i>P</i> _{trend}]	19 12 19 9	1.73 (0.82-3.63) 1.00 1.73 (0.84-3.57) 1.11 (0.46-2.65) [0.73]	Age, smoking status, blood glucose, occupational group, baseline BMI	
Sjödahl et al. (2008) Nord-Trøndelag Health Study Norway 1984-2002	73 133 Men and women Incidence	Stomach, adenocarcinoma ICD-7: 151.0, 151.8, 151.9	BMI < 18.5 18.5-24.9 25-29.9 ≥ 30 [<i>P</i> _{trend}]	3 104 110 32	0.7 (0.1-5.2) 1.0 1.0 (0.7-1.4) 1.1 (0.7-1.8) [0.74]	Age, sex, physical activity, occupation, salt intake, smoking, alcohol consumption	
Whitlock et al. (2009) Pooled analysis of 57 cohort studies Europe and North America Follow-up varied by cohort	894 576 Men and women Mortality	Stomach ICD-9: 151	BMI, per 5 kg/m ² For BMI 15-25 For BMI 25-50 For BMI 15-50	934 651	0.86 (0.70-1.05) 1.11 (0.94-1.32) 0.98 (0.90-1.07)	Study, sex, age, smoking	
Parr et al. (2010) Pooled analysis of 39 cohort studies Asia, Australia, and New Zealand 1961-1999, median follow-up 4 yr	326 387 Men and women Mortality	Stomach ICD-9: 151 ICD-10: C16	BMI 12-< 18.5 18.5-24.9 25-29.9 ≥ 30 [<i>P</i> _{trend}]	NR	1.19 (0.87-1.62) 1.00 1.05 (0.88-1.25) 1.04 (0.67-1.63) [0.66]	Age, sex, smoking	
Chen et al. (2012) Population-based cohort of men China 1990-2006	142 214 Men Mortality	Stomach	BMI 15-23.5 23.5-35	757 198	0.74 (0.59-0.94) 0.96 (0.61-1.49)	Age, area, smoking, alcohol consumption, education level	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Lindkvist et al. (2013)	289 866 Men Incidence	Stomach ICD-7: 151	BMI, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}]	157 134 154 197 186	1.00 0.79 (0.62–0.99) 0.84 (0.67–1.05) 1.02 (0.83–1.26) 1.00 (0.80–1.24) [0.26]	Smoking, age, study cohort, year of birth	Ranges of BMI quintiles not specified
Metabolic Syndrome and Cancer Project (Me-Can) pooled analysis of prospective cohorts Austria, Norway, and Sweden 1972–2006, follow- up varied by cohort	288 834 Women Incidence	Stomach ICD-7: 151	BMI, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}]	59 65 63 104 91	1.00 0.92 (0.65–1.31) 0.73 (0.51–1.05) 1.01 (0.72–1.40) 0.85 (0.61–1.20) [0.68]	Smoking, age, study cohort, year of birth	Ranges of BMI quintiles not specified
Bhaskaran et al. (2014)	5 243 978 Incidence	Stomach ICD-10: C16	BMI per 5 kg/m ² increase [<i>P</i> _{trend}]	3337 total	1.03 (0.98–1.09) [0.16]	Age, sex, diabetes, smoking, alcohol consumption, SES, calendar year	Stronger association in non-smokers
Camargo et al. (2014)	483 700 Men and women Incidence	Stomach ICD-10: C16.0–16.9	BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 Weight, tertiles T1 T2 T3	1000 total	1.00 1.05 (0.90–1.22) 1.40 (1.16–1.68) 1.57 (1.21–2.04)	Age, sex, education level, cigarette smoking	
NIH-AARP cohort USA 1995–2006					1.00 1.00 (0.86–1.17) 1.18 (1.01–1.38)		

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
<i>Gastric cardia</i>							
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence	Gastric cardia ICD-9: 151.0	Obesity Non-obese Obese	White men: 841 72	1.00 1.38 (1.09–1.77)	Age, calendar year	Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0 Only 5 cases were available among Black men
Lindblad et al. (2005) Case-control study nested in General Practitioner Research Database United Kingdom 1994–2001	10 195 Men and women Incidence	Gastric cardia	BMI < 20 20–24 25–29 ≥ 30 [<i>P</i> _{trend}]	2 36 55 20	0.50 (0.12–2.10) 1.00 1.37 (0.89–2.10) 1.46 (0.84–2.54) [0.04]	Age, sex, calendar year, smoking, alcohol consumption, reflux	
Tran et al. (2005) Linxian General Population Trial China 1986–2001	29 584 Men and women Incidence	Gastric cardia	BMI < 20 20–21 22 ≥ 23 [<i>P</i> _{trend}]	1089 total	1.00 0.98 (0.84–1.16) 0.96 (0.81–1.13) 0.95 (0.80–1.13) [0.51]	Age, sex	
Samanic et al. (2006) Swedish Construction Worker Cohort Sweden 1958–1999	362 552 Men Incidence	Gastric cardia ICD-7: 151.0	BMI 18.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	108 105 16	1.00 1.16 (0.88–1.52) 1.09 (0.64–1.85) [0.40]	Attained age, calendar year, smoking	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Merry et al. (2007) Netherlands Cohort Study The Netherlands 1986–1999	4774 Men and women Incidence	Gastric cardia ICD-O-3: C16.0 Histology: 8140– 8141, 8190–8231, 8260–8263, 8310, 8430, 8480–8490, 8560, 8570–8572	BMI at baseline < 20 20–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}] BMI at age 20 yr < 20 20–21.4 21.5–22.9 23.0–24.9 ≥ 25 [<i>P</i> _{trend}] BMI change, age 20 yr to baseline < 0 0–3.9 4–7.9 ≥ 8 [<i>P</i> _{trend}]	2 68 76 17 21 40 39 22 16 10 70 45 13	0.67 (0.16–2.80) 1.00 1.32 (0.94–1.85) 2.73 (1.56–4.79) [0.002] 0.66 (0.39–1.14) 1.00 1.02 (0.65–1.60) 0.75 (0.44–1.28) 1.47 (0.81–2.70) [0.17] 0.68 (0.34–1.35) 1.00 1.22 (0.82–1.82) 2.07 (1.08–3.97) [0.02]	Age, sex	
Abnet et al. (2008) NIH-AARP cohort USA 1995–2003	480 475 Men and women Incidence	Gastric cardia ICD-O-3: C16.0 Histology: “adenocarcinoma”	BMI < 18.5 18.5–24.9 25–29.9 30–34.9 ≥ 35	1 76 128 71 31	0.70 (0.10–5.06) 1.00 1.06 (0.79–1.41) 1.70 (1.22–2.36) 2.46 (1.60–3.80)	Age, sex, cigarette smoking, alcohol consumption, education level, physical activity	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Corley et al. (2008) Nested case- control of Kaiser Permanente Multiphasic Health Check-up cohort USA 1964–1973	3150 Men and women Incidence	Gastric cardia ICD-10: C16.0 Histology: 8140–8573	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 per 1 kg/m ² increase Sagittal abdominal diameter (cm) < 20 20–22.4 22.5–25 ≥ 25 per 1 cm increase	0 43 40 16 16 12 12 14	– 1.00 0.91 (0.55–1.53) 2.04 (0.99–4.21) 1.04 (0.98–1.09) 1.00 0.69 (0.29–1.60) 1.17 (0.49–2.84) 1.28 (0.38–4.25) 1.03 (0.95–1.11)	Age, sex, year of health check-up BMI results also adjusted for ethnicity	
O’Doherty et al. (2012) NIH-AARP cohort USA 1995–2006	218 854 Men and women Incidence	Gastric cardia ICD-10: C16.0	BMI < 18.5 18.5–24.9 25–29.9 30–34.9 ≥ 35 [<i>P</i> _{trend}] Weight, quartiles (sex-specific) Q1 Q2 Q3 Q4 [<i>P</i> _{trend}]	2 50 79 45 15	2.57 (0.62–10.65) 1.00 1.15 (0.80–1.65) 2.16 (1.41–3.29) 3.67 (2.00–6.71) [< 0.01]	Age, sex, total energy intake, antacid use, aspirin use, NSAID use, marital status, diabetes, cigarette smoking, education level, ethnicity, alcohol consumption, physical activity, diet	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
O'Doherty et al. (2012) (cont.)			WC, quartiles (sex-specific) Q1 Q2 Q3 Q4 [<i>P</i> _{trend}]	30 38 51 72	1.00 1.32 (0.82–2.14) 1.29 (0.82–2.04) 2.22 (1.43–3.47) [< 0.01]		
Camargo et al. (2014) NIH-AARP cohort USA 1995–2006	483 700 Men and women Incidence	Gastric cardia ICD-10: C16.0	BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 Weight, tertiles T1 T2 T3	478 total	1.00 1.10 (0.87–1.38) 1.64 (1.26–2.14) 2.24 (1.58–3.17) 1.00 1.20 (0.94–1.52) 1.53 (1.21–1.92)	Age, sex, education level, cigarette smoking	
Steffen et al. (2015) EPIC cohort 10 European countries 1992–2008	391 456 Men and women Incidence/mortality	Gastric cardia ICD-10: C16.0	BMI, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}] Weight, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}]	31 37 48 41 36	1.00 1.09 (0.68–1.77) 1.37 (0.87–2.17) 1.20 (0.74–1.94) 1.17 (0.71–1.92) [0.53] 1.00 1.14 (0.71–1.84) 1.29 (0.81–2.08) 1.11 (0.68–1.83) 1.26 (0.75–2.10) [0.48]	Age, centre, sex, education level, smoking, alcohol consumption, physical activity, diet, height	Sex-specific quintiles for weight, BMI, and WC. Cut- off points not provided, only the median values for each

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Steffen et al. (2015) (cont.)			WC, quintiles				
			Q1	22	1.00		
			Q2	31	1.20 (0.69–2.09)		
			Q3	40	1.41 (0.83–2.40)		
			Q4	42	1.52 (0.89–2.58)		
			Q5	45	1.59 (0.93–2.73)		
			[<i>P</i> _{trend}]		[0.06]		
<i>Gastric non-cardia</i>							
Samanic et al. (2004)	4 500 700 Men Incidence	Gastric non-cardia ICD-9: 151.x	Obesity			Age, calendar year	Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0
United States Veterans cohort USA 1969–1996			Non-obese	White men: 4148	1.00		
			Obese	237	1.00 (0.88–1.14)		
			Non-obese	Black men: 1958	1.00		
			Obese	94	0.99 (0.80–1.22)		
Lindblad et al. (2005)	10 327 Men and women Incidence	Gastric non-cardia	BMI			Age, sex, calendar year, smoking, alcohol consumption, reflux	
Case-control study nested in General Practitioner Research Database United Kingdom 1994–2001			< 20	16	1.75 (1.00–3.08)		
			20–24	70	1.00		
			25–29	83	1.11 (0.80–1.54)		
			≥ 30	23	0.87 (0.54–1.41)		
			[<i>P</i> _{trend}]		[0.18]		
Tran et al. (2005)	29 584 Men and women Incidence	Gastric non-cardia	BMI	363 total		Age, sex	
Linxian General Population Trial China 1986–2001			< 20		1.00		
			20–21		1.00 (0.76–1.32)		
			22		0.91 (0.68–1.20)		
			≥ 23		0.68 (0.49–0.93)		
			[<i>P</i> _{trend}]		[0.017]		

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
MacInnis et al. (2006) Melbourne Collaborative Cohort Study Australia 1990–2004	41 295 Men and women Incidence/mortality	Gastric non-cardia ICD-9: 151.1–151.9 ICD-10: C16.1–16.9	BMI < 25 25–29 ≥ 30 [<i>P</i> _{trend}] Weight (kg) Men: < 75 75–83 ≥ 84 [<i>P</i> _{trend}] WC (cm) Men: < 94 94–101 ≥ 102 [<i>P</i> _{trend}]	68 total	1.0 0.5 (0.3–1.0) 1.0 (0.5–1.8) [0.76] 1.0 0.6 (0.3–1.1) 1.1 (0.6–1.9) [0.62] 1.0 0.8 (0.4–1.4) 1.1 (0.6–2.0) [0.57]	Sex, country of birth, education level, physical activity	
Samanic et al. (2006) Swedish Construction Worker Cohort Sweden 1958–1999	362 552 Men Incidence	Gastric non-cardia ICD-7: 151.x	BMI 18.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	558 426 68	1.00 0.81 (0.72–0.92) 0.78 (0.61–1.01) [< 0.01]	Attained age, calendar year, smoking	
Merry et al. (2007) Netherlands Cohort Study The Netherlands 1986–1999	4774 Men and women Incidence	Gastric non-cardia ICD-10: C16.1–16.5 Histology: 8140– 8141, 8190–8231, 8260–8263, 8310, 8430, 8480–8490, 8560, 8570–8572	BMI at baseline < 20 20–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	12 115 99 9	1.80 (0.96–3.39) 1.00 0.97 (0.73–1.30) 0.68 (0.34–1.35) [0.13]	Age, sex, current smoking, number of cigarettes smoked per day, smoking duration, education level	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Merry et al. (2007) (cont.)			BMI at age 20 yr				
			< 20	53	1.40 (0.91–2.15)		
			20–21.4	40	1.00		
			21.5–22.9	49	1.24 (0.80–1.91)		
			23.0–24.9	36	1.12 (0.69–1.80)		
			≥ 25	20	1.60 (0.91–2.83)		
			[<i>P</i> _{trend}]		[0.93]		
			BMI change, age 20 yr to baseline				
			< 0	17	0.77 (0.44–1.36)		
			0–3.9	106	1.00		
			4–7.9	61	0.85 (0.60–1.21)		
			≥ 8	14	0.86 (0.46–1.59)		
			[<i>P</i> _{trend}]		[0.77]		
Abnet et al. (2008) NIH-AARP cohort USA 1995–2003	480 475 Men and women Incidence	Gastric non-cardia ICD-O-3: C16.1–16.9 Histology: “adenocarcinoma”	BMI			Age, sex, cigarette smoking, alcohol consumption, education level, physical activity	
			< 18.5	7	2.97 (1.38–6.39)		
			18.5–24.9	107	1.00		
			25–29.9	123	0.80 (0.61–1.04)		
			30–34.9	61	1.08 (0.78–1.50)		
			≥ 35	17	0.84 (0.50–1.42)		
Persson et al. (2008) Japan Public Health Center-based Prospective Study Japan 1990–2004	44 453 Women Incidence	Stomach, non- cardia ICD-10: C16.2-16.7	BMI			Age, family history of gastric cancer, study area	Similar results in postmenopausal women only
			< 20	53	1.00		
			20–24.9	225	0.82 (0.61–1.11)		
			≥ 25	90	0.74 (0.53–1.04)		
			[<i>P</i> _{trend}]		[0.10]		
		Stomach, non-cardia, differentiated cancer type	BMI				Similar results in postmenopausal women only
			< 20	12	1.00		
			20–24.9	56	0.93 (0.50–1.74)		
			≥ 25	29	1.12 (0.57–2.21)		
		ICD-10: C16.2-16.7	[<i>P</i> _{trend}]		[0.59]		

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Persson et al. (2008) (cont.)		Stomach, non-cardia, undifferentiated cancer type ICD-10: C16.2-16.7	BMI < 20 20–24.9 ≥ 25 [<i>P</i> _{trend}]	37 153 52	1.00 0.79 (0.55–1.14) 0.60 (0.39–0.91) [0.01]		Similar results in postmenopausal women only
Sjödahl et al. (2008) Nord-Trondelag Health Study Norway 1984–2002	73 133 Men and women Incidence	Gastric non-cardia ICD-7: 151.0, 151.8, 151.9	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	2 84 92 29	0.9 (0.1–6.7) 1.0 1.1 (0.7–1.6) 1.2 (0.7–2.1) [0.42]	Age, sex, physical activity, occupation, salt intake, smoking, alcohol consumption	
O’Doherty et al. (2012) NIH-AARP cohort USA 1995–2006	218 854 Men and women Incidence	Gastric non-cardia ICD-10: C16.1–16.7	BMI < 18.5 18.5–24.9 25–29.9 30–34.9 ≥ 35 [<i>P</i> _{trend}] Weight, quartiles (sex-specific) Q1 Q2 Q3 Q4 [<i>P</i> _{trend}] WC, quartiles (sex-specific) Q1 Q2 Q3 Q4 [<i>P</i> _{trend}]	1 37 60 23 4 20 35 32 38 21 26 40 38	1.34 (0.18–9.79) 1.00 1.32 (0.86–2.00) 1.46 (0.84–2.51) 0.99 (0.34–2.84) [0.38] 1.00 1.93 (1.10–3.38) 1.73 (0.96–3.10) 1.93 (1.05–3.54) [0.07] 1.00 1.27 (0.71–2.26) 1.41 (0.82–2.41) 1.46 (0.83–2.55) [0.19]	Age, sex, total energy intake, antacid use, aspirin use, NSAID use, marital status, diabetes, cigarette smoking, education level, ethnicity, alcohol consumption, physical activity, diet	

Table 2.2.3a (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site or cancer type (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Camargo et al. (2014) NIH-AARP cohort USA 1995–2006	483 700 Men and women Incidence	Gastric non-cardia ICD-10: C16.1–16.6	BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 Weight, tertiles T1 T2 T3	522 total	1.00 1.09 (0.83–1.43) 1.38 (0.99–1.92) 1.05 (0.61–1.82) 1.00 1.00 (0.76–1.32) 1.02 (0.77–1.34)	Age, sex, education level, cigarette smoking	
Steffen et al. (2015) EPIC cohort 10 European countries 1992–2008	391 456 Men and women Incidence/mortality	Gastric non-cardia ICD-10: C16.1–16.9	BMI, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}] Weight, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}] WC, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}]	36 36 33 49 70 50 35 36 57 46 25 25 33 66 55	1.00 0.77 (0.48–1.22) 0.61 (0.38–0.99) 0.78 (0.50–1.22) 0.99 (0.64–1.54) [0.41] 1.00 0.68 (0.44–1.06) 0.67 (0.43–1.06) 1.02 (0.68–1.55) 0.84 (0.53–1.32) [0.94] 1.00 0.81 (0.46–1.42) 0.89 (0.52–1.52) 1.58 (0.97–2.57) 1.14 (0.68–1.91) [0.12]	Sex, education level, smoking, alcohol consumption, physical activity, diet, height	Sex-specific quintiles for weight, BMI, and WC. Cut- off points not provided, only the median values for each

BMI, body mass index (in kg/m²); BP, blood pressure; CI, confidence interval; EPIC, European Prospective Investigation into Cancer and Nutrition; HRT, hormone replacement therapy; ICD, International Classification of Diseases; JACC, Japan Collaborative Cohort Study for Evaluation of Cancer Risk; NIH-AARP, National Institutes of Health–AARP Diet and Health Study; NSAID, non-steroidal anti-inflammatory drug; SES, socioeconomic status; VHM&PP, Vorarlberg Health Monitoring and Prevention Program; WC, waist circumference; yr, year or years

Table 2.2.3b Case-control studies of measures of body fatness and cancer of the stomach

Reference Study location Period	Total number of cases Source of controls	Organ site	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding	Comments
<i>Stomach</i>							
Hansson et al. (1994) Sweden 1989–1992	338 Population	Stomach	BMI at age 20 yr			Age, height	No differences were observed in the associations by age at interview (age groups: < 59 yr, 60–69 yr, and ≥ 70 yr) No associations were found between BMI and GC 20 yr before the interview
			≤ 21.20	Men: 37	1.00		
			21.21–22.60	40	1.06 (0.63–1.86)		
			22.62–24.20	45	1.09 (0.66–1.82)		
			≥ 24.21	84	2.16 (1.35–3.46)		
			continuous		1.12 (1.05–1.20)		
			≤ 19.20	Women: 12	1.00		
			19.21–20.80	18	1.39 (0.60–3.23)		
			20.81–23.30	40	3.06 (1.43–6.58)		
			≥ 23.21	28	2.14 (0.96–4.78)		
			continuous		1.11 (1.02–1.21)		
Muñoz et al. (2001) Venezuela 1991–1997	292 Population	Stomach	BMI			Age, sex	Similar results for self-reported weight at current age. Increased risk in overweight cases with self-reported weight in childhood, adolescence, and early adulthood
			< 18.5	51	11.0 (4.8–27.0)		
			18.5–25.0	200	1.0		
			> 25.0	41	0.3 (0.2–0.4)		
Inoue et al. (2002) Japan 1988–1998	Women: 365 Population	Stomach	Current BMI			Age, year, season of interview, family history of GC, smoking status, intake of raw vegetables and fish	Postmenopausal women only. <i>P</i> values for trend were non-significant among all subsites, both for current BMI and for BMI at age 20 yr
		Upper third	< 21.08	72 total	1.00		
			21.08–23.56		1.69 (0.91–3.12)		
			> 23.56		1.07 (0.54–2.10)		
		Middle third	< 21.08	155 total	1.00		
			21.08–23.56		0.75 (0.49–1.16)		
			> 23.56		0.80 (0.52–1.22)		
		Lower third	< 21.08	127 total	1.00		
			21.08–23.56		1.02 (0.63–1.66)		
			> 23.56		1.16 (0.72–1.89)		

Table 2.2.3b (continued)

Reference Study location Period	Total number of cases Source of controls	Organ site	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding	Comments
Inoue et al. (2002) (cont.)			BMI at age 20 yr				
		Upper third	< 21.08 21.08–23.56 > 23.56	72 total	1.00 1.33 (0.69–2.55) 1.33 (0.69–2.58)		
		Middle third	< 21.08 21.08–23.56 > 23.56	155 total	1.00 1.83 (1.14–2.94) 1.81 (1.12–2.93)		
		Lower third	< 21.08 21.08–23.56 > 23.56	127 total	1.00 0.88 (0.52–1.50) 1.31 (0.81–2.12)		
Chung et al. (2010) Republic of Korea 1990–2008	Men: 374 Women: 270 Hospital	Stomach	Current BMI > 35 vs ≤ 35 > 35 vs ≤ 35	Men: 374 total Women: 270 total	1.94 (1.63–2.37) 1.65 (1.34–2.04)	Age	Study in young individuals (ages 18–45 yr)
Praud et al. (2014) Italy 1985–2007	Men: 612 Women: 387 Hospital	Stomach	BMI < 25 vs ≥ 25 [<i>P</i> _{trend}] < 25 vs ≥ 25 [<i>P</i> _{trend}]	Men: 646 total Women: 348 total	0.85 (0.79–0.90) [< 0.0001] 0.86 (0.79–0.93) [0.0009]	Age, sex, study, year of interview, education level, tobacco smoking, family history, total energy intake	
Kim et al. (2015) Republic of Korea 2003–2013	Men: 663 Women: 335 Hospital	Stomach	BMI measured at endoscopy < 23 23– < 25 ≥ 25– < 30 ≥ 30 [<i>P</i> _{trend}]	Men: 286 193 175 9	1.00 1.25 (0.87–1.81) 1.33 (0.92–1.92) 1.27 (0.42–3.86) [0.43]	Age, smoking status, drinking status, family history of GC, <i>Helicobacter pylori</i> infection, atrophic gastritis, intestinal metaplasia, serum pepsinogen I/II ratio	No significant associations were observed when stratifying by cardia and non-cardia GC

Table 2.2.3b (continued)

Reference Study location Period	Total number of cases Source of controls	Organ site	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding	Comments
Kim et al. (2015) (cont.)			< 23 23– < 25 ≥ 25– < 30 ≥ 30 [<i>P</i> _{trend}]	Women: 182 73 69 11	1.00 0.92 (0.6–1.43) 1.11 (0.70–1.77) 0.86 (0.33–2.26) [0.904]		
Song et al. (2015) Republic of Korea 2010–2014	1492 Population	Stomach	BMI at age 18 yr 21.75 ≥ 25.3 21.75 ≥ 25.3	Men: 1.00 1.13 (1.01–1.55) Women: 1.00 1.25 (1.01–1.55)		Age, smoking status, alcohol drinking status, regular exercise, family history of GC, past medical history	
<i>Gastric cardia</i>							
Vaughan et al. (1995) USA (13 counties of Washington State) 1993–1990	165 Population	Gastric cardia, adenocarcinoma	BMI, percentiles 1–10% 10–49% 50–89% 90–100%	13 52 74 25	0.8 (0.4–1.8) 1.0 1.3 (0.8–2.1) 1.6 (0.8–3.0)	Age, sex, education level, race, cigarette smoking, alcohol consumption	BMI percentiles (derived from in-person interviews) based on distribution of controls for each sex separately
Chow et al. (1998) USA 1993–1995	365 Population	Gastric cardia	BMI (sex-specific) Men: < 23.12 23.12–25.08 25.09–27.31 ≥ 27.32 [<i>P</i> _{trend}] Women: < 21.95 21.95–24.12 24.13–27.43 ≥ 27.44	54 51 70 86	1.0 0.9 (0.6–1.5) 1.4 (0.9–2.1) 1.6 (1.1–2.6) [0.008]	Geographical location, age, sex, race, cigarette smoking, respondent status	BMI up to 1 yr before diagnosis for cases and date of interview for controls

Table 2.2.3b (continued)

Reference Study location Period	Total number of cases Source of controls	Organ site	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding	Comments
Lagergren et al. (1999) Sweden 1995–1997	262 Population	Gastric cardia	BMI 20 yr before interview				Age, sex, tobacco smoking, alcohol consumption, SES, reflux symptoms, intake of fruits and vegetables, energy intake, physical activity
			< 22	47	1.0		
			22–24.9	100	1.3 (0.8–1.9)		
			25–30	91	2.2 (1.4–3.4)		
			> 30	24	4.3 (2.1–8.7)		
			[<i>P</i> _{trend}]		< 0.001]		
			BMI at age 20 yr, quartiles (sex-specific)				
			Men:	Women:			
			< 20.7	< 19.3	52	1.0	
			20.7–22.1	19.3–20.4	46	0.8 (0.5–1.3)	
22.2–23.7	20.5–22.1	65	1.2 (0.8–1.9)				
> 23.7	> 22.1	99	1.9 (1.3–2.9)				
[<i>P</i> _{trend}]		< 0.001]					
Wu et al. (2001) USA 1992–1997	277 Population (proxy control)	Gastric cardia	BMI at age 40 yr, quartiles (sex-specific)				Smoking, age, sex, race, education level
			Men:	Women:	247 total		
			≤ 22	≤ 21		1.00	
			> 22–≤ 25	> 21–≤ 23		1.49 (1.0–2.1)	
			> 25–≤ 27	> 23–≤ 25		1.45 (0.9–2.3)	
			> 27	> 25		2.08 (1.4–3.2)	
			[<i>P</i> _{trend}]		[0.016]		
			BMI at age 20 yr, quartiles (sex-specific)				
			Men:	Women:	246 total		
			≤ 20	≤ 18		1.00	
> 20–≤ 22	> 18–≤ 20		1.13 (0.8–1.7)				
> 22–≤ 24	> 20–≤ 22		1.36 (0.9–2.0)				
> 24	> 22		1.71 (1.2–2.6)				
[<i>P</i> _{trend}]		[0.006]					
<i>Gastric non-cardia</i>							
Chow et al. (1998) USA 1993–1995	365 Population	Gastric non-cardia	BMI up to 1 yr before diagnosis (sex-specific)				Geographical location, age, sex, race, cigarette smoking, respondent status
			Men:	Women:			
			< 23.12	< 21.95	105	1.0	
			23.12–25.08	21.95–24.12	77	0.9 (0.6–1.4)	
			25.09–27.31	24.13–27.43	91	1.2 (0.8–1.8)	
≥ 27.32	≥ 27.44	92	1.2 (0.8–1.8)				
[<i>P</i> _{trend}]		[2.14]					

Table 2.2.3b (continued)

Reference Study location Period	Total number of cases Source of controls	Organ site	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding	Comments
Wu et al. (2001) USA 1992–1997	443 Population	Gastric non-cardia	BMI at age 40 yr, quartiles (sex-specific) Men: ≤ 22 > 22–≤ 25 > 25–≤ 27 > 27 [<i>P</i> _{trend}]	Women: ≤ 21 > 21–≤ 23 > 23–≤ 25 > 25 352 total	1.00 0.86 (0.6–1.2) 1.00 (0.7–1.5) 1.10 (0.8–1.6) [0.57]	Smoking, age, sex, race, education level	Results did not change when stratifying by Whites/non-Whites or by sex
			BMI at age 20 yr, quartiles (sex-specific) Men: ≤ 20 > 20–≤ 22 > 22–≤ 24 > 24 [<i>P</i> _{trend}]	Women: ≤ 18 > 18–≤ 20 > 20–≤ 22 > 22 352 total	1.00 1.21 (0.9–1.7) 1.39 (1.0–2.0) 1.43 (1.0–2.1) [0.03]		

BMI, body mass index (in kg/m²); CI, confidence interval; GC, gastric cancer; SES, socioeconomic status; yr, year or years

Table 2.2.3c Meta-analyses of measures of body fatness and cancer of the stomach

Reference Period	Total number of studies Total number of cases	Organ site	Exposure categories	Relative risk (95% CI)	Adjustment for confounding	Comments
Renehan et al. (2008) 1996–2007	Men: 8 prospective studies 817 incident cases	Stomach	BMI per 5 kg/m ² increase	0.97 (0.88–1.06)	Age (all studies) and other factors (not in all studies)	
	Women: 5 prospective studies 325 incident cases	Stomach	BMI per 5 kg/m ² increase	1.04 (0.90–1.20)		
Yang et al. (2009) 1950–2009	12 prospective studies 9492 incident cases	Stomach	BMI		NR	No differences in risk by sex; normal, overweight, and obese are defined in most studies as BMI of 18.5–25, 25–29.9, and ≥ 30, respectively
			Overweight and obese vs normal	1.22 (1.06–1.41)		
			Obese vs normal	1.36 (1.21–1.54)		
	3 prospective studies	Cardia	BMI		NR	
			Overweight and obese vs normal	1.55 (1.31–1.84)		
			Obese vs normal	2.06 (1.63–2.61)		
4 prospective studies	Non-cardia	BMI		NR		
		Overweight and obese vs normal	1.40 (1.16–1.68)			
		Obese vs normal	1.18 (0.96–1.45)			
Chen et al. (2013) 1994–2012	12 prospective studies 41 791 incident cases	Stomach	BMI			Stronger associations in men in both BMI groups
			18.5– < 25	1.00		
			25–29.9	1.01 (0.96–1.07)		
	7 prospective studies	Cardia	BMI			
			18.5– < 25	1.00		
			25–29.9	1.21 (1.03–1.42)		
	8 prospective studies	Non-cardia	BMI			
			18.5– < 25	1.82 (1.32–2.49)		
			25–29.9	1.00		
			18.5– < 25	1.00		
			25–29.9	0.93 (0.82–1.05)		
			≥ 30	1.00 (0.87–1.15)		

Table 2.2.3c (continued)

Reference Period	Total number of studies Total number of cases	Organ site	Exposure categories	Relative risk (95% CI)	Adjustment for confounding	Comments
Lin et al. (2014) NR	13 prospective studies and 3 case-controls NR	Stomach	BMI	1.00	Age and others (not specified)	Stronger association of obesity with risk in men (5 studies) and in non-Asian population (11 studies)
			18.5- < 25	1.13 (1.03-1.24)		
			25-29.9	1.04 (0.96-1.12)		
		Cardia	BMI	1.00	Age and others (not specified)	
			18.5- < 25	1.61 (1.15-2.24)		
			25-29.9	1.22 (1.05-1.42)		
Non-cardia	BMI	1.00	Age and others (not specified)			
	18.5- < 25	0.83 (0.68-1.01)				
	25-29.9	0.94 (0.81-1.10)				

BMI, body mass index (in kg/m²); CI, confidence interval; CRC, colorectal cancer; HRT, hormone replacement therapy; IBD, inflammatory bowel disease; NR, not reported

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