



**RED MEAT AND  
PROCESSED MEAT**

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OF CARCINOGENIC RISKS  
TO HUMANS**

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled	
Yu et al. (1988) United States of America – Los Angeles County 1st January 1975–31st August 1981	<p><b>Cases:</b> 275; Incident cases of oesophageal cancer aged 20–64, diagnosed between January 1975 and March 1981, histologically confirmed and identified through the Los Angeles County Cancer Surveillance Program (population-based registry recording all cases of cancer that are microscopically verified or mentioned on a death certificate)</p> <p><b>Controls:</b> 275; Population controls selected from the neighbourhood of the cases' residence at the time of diagnosis (using a systematic canvassing of the residential units around the case's residence), matched on sex, year of birth, "race" (this last matching criterion was not strictly adhered to if no potential control was identified within 80 housing units)</p> <p><b>Exposure assessment method:</b> Questionnaire; Dietary habits were assessed through a series of questions related to the usual frequency of consumption of a few broad food groups; among these food groups, "Fried bacon and ham" can be used to estimate "processed meat" consumption.</p>	Oesophagus	All			Sex, year of birth, "race"	
			Fried bacon or ham				
			Group 1 (1/week or less)	133	1		
			Group 2 (2–4/week)	91	1.4 (0.9–2.1)		
			Group 3 (5+/week)	41	2 (1.1–3.5)		
		Oesophagus	Barbecued or smoked meat				Same as above
			Group 1 (1/week or less)	237	1		
			Group 2 (2+/week)	31	1.7 (0.9–3)		
		Oesophagus	Directly interviewed				Same as above
			Fried bacon or ham				
	Group 1 (1/week or less)	67	1				
	Group 2 (2–4/week)	37	1.1 (0.6–2)				
	Group 3 (5+/week)	24	3.4 (1.4–8.2)				
Oesophagus	Barbecued or smoked meat				Same as above		
	Group 1 (1/week or less)	120	1				
	Group 2 (2+/week)	9	1 (0.4–2.7)				

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Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled		
Brown et al. (1995) The United States 1986–1989	<b>Cases:</b> 162; Residents of three population-based cancer registries, white men of 30–79 years <b>Controls:</b> 685; Random sampling from computerized listings of Medicare recipients aged 30–64 years (Population-based) <b>Exposure assessment method:</b> Questionnaire; A 60-item FFQ, recalled usual adult frequency excluding the past 5 years	Oesophagus adenocarcinoma and the esophagogastric junction	Processed meats			Age, area, smoking, liquor use, income, calories from food, BMI		
			Quartiles 1 (lowest)	1	-			
			Quartiles 2	1.0	-			
			Quartiles 3	0.8	-			
			Quartiles 4 (highest)	0.7	-			
			Trend-test p-value: 0.28					
Brown et al. (1998) United States of America – Atlanta, Detroit, New Jersey 1st August 1986–30th April 1989	<b>Cases:</b> 333; Incident cases of oesophageal cancer histologically confirmed in “white” and “black” male patients (that are treated as two separate study populations: 114 “white” and 219 “black” cases) <b>Controls:</b> 1795; Population-based controls selected to be similar to the expected age, gender and area distribution of the cases. There are two separate populations of controls (681 “whites” and 557 “black” controls). Controls aged 30–64 years were selected using a random-digit dialing technique, whereas controls aged 65–79 years were randomly chosen from computerized listings of Medicare registrants. <b>Exposure assessment method:</b> Questionnaire; Assessment of dietary intake was based on a questionnaire about 60 specific food items about which individuals were asked to recall their usual frequency of consumption (excluding the five past years); “Processed meat” was defined as consumption of “bacon or sausage, lunch meat, hot dogs, other pork or ham.”	Oesophagus Squamous cell	Processed Meat, quartiles “White” male			Age, area, smoking, alcohol, food calories		
		Q1	NR	1				
		Q2	NR	1.5				
		Q3	NR	1.1				
		Q4 (≥ 8.5 servings per week)	NR	1.7				
					Trend-test p-value: 0.25			
			Oesophagus Squamous cell carcinoma	“Black” male				Same as above
		Q1	NR	1				
		Q2	NR	0.7				
		Q3	NR	1.6				
Q4 (≥ 8.5 servings per week)	NR	1.6						
			Trend-test p-value: 0.04					

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled	
Bosetti et al. (2000) Northern Italy (provinces of Milan, Pordenone and Padova) 1992–1997	<p><b>Cases:</b> 304; Incident cases of histologically confirmed squamous cell carcinoma of the oesophagus admitted to the major teaching and general hospitals in the areas under study.</p> <p><b>Controls:</b> 743; Hospital-based controls admitted to the same hospitals as the cases with non-neoplastic diseases, and conditions not related to smoking or alcohol consumption and long-term modification of diet. Controls were frequency-matched with cases based on age (5-year age groups), sex, year of interview and area of residence.</p> <p><b>Exposure assessment method:</b> Questionnaire; Dietary information was obtained a FFQ including 78 specific foods and beverages as well as a range of the most common meal recipes in the Italian diet. Dietary intake was assessed in terms of the average weekly frequency of consumption during the two years before cancer diagnosis or hospital admission.</p> <p>Cumulative weekly intake of each food group was obtained by summing the frequency of consumption of individual food items in the same group and then forming approximate marginal quintiles.</p> <p>There is no detail in the text about the definition of “processed meat” (we have found in Franceschi et al., 1999 that processed meat was assessed from three questions of the FFQ and we gather from the text that it at least included ham, salami and sausages, and prosciutto (the latter being characterized as 'lean processed meat')).</p>	Oesophagus Squamous cell carcinoma	All – Processed meat	NR	1	Age, sex, area of residence, education, tobacco smoking, alcohol drinking, non-alcohol energy	
			Q1 (< 1.4 servings/week)				
			Q2 (1.4–1.9 servings/week)	NR	0.92 (0.55–1.56)		
			Q3 (1.9–2.9 servings/week)	NR	0.94 (0.57–1.56)		
			Q4 (2.9–4.4 servings/week)	NR	1.1 (0.68–1.78)		
			Q5 (> 4.4 servings/week)	NR	1.39 (0.85–2.26)		
			Trend-test p-value: 0.171				

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
Takezaki et al. (2001) People's Republic of China – Pizhou City (Jiangsu Province) 1996 (1995 for controls)–2000	<b>Cases:</b> 199 for esophageal and 187 for stomach cancer; Incident cases of histopathologically confirmed cases of primary oesophageal cancer (ICD-O C15) and stomach cancer who visited Pizhou City Municipal Hospital <b>Controls:</b> 333; Healthy residents of Pizhou, matched on sex, ethnicity and age within 2 years of each case. Controls came from three different sources: a population-based ecological study conducted in 1995–1996; individuals collected between 1995 and 1998 in the general population; individuals collected between 1998 and 2000. <b>Exposure assessment method:</b> Questionnaire; Food consumption frequency was measured at the time of interview and 10 years previously; Among the available items, only “salted meat” can be used to estimate “processed meat” consumption. Previously used in case-control and ecological study.	Oesophagus	All – Salted meat	NR	1	Age, sex, smoking, drinking
			Group 1 (< 1 time/month)			
			Group 2 (1–3 times/month)	NR	1.34 (0.72–2.48)	
			Group 3 (≥ 1 time/week)	NR	0.93 (0.38–2.29)	
			Trend-test p-value: 0.708			

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled	
Hung et al. (2004) Taiwan, China 1996–2002	<p><b>Cases:</b> 284; Incident cases of histologically confirmed oesophageal cancer (squamous cell carcinoma) from three medical centres (National Taiwan, China University Hospital, Kaohsiung Medical University Hospital, Kaohsiung Veterans General Hospital). Mean age 62.4 years (range 41–93 years). Male.</p> <p><b>Controls:</b> 504; Matched controls (1–3 controls/case) selected from individuals visiting the Department of Preventive Medicine for routine physical examination. Controls were matched to the cases with respect to the date of hospitalization and age (+/- 3 years). 60.8 years (range: 41–89 years). Male.</p> <p><b>Exposure assessment method:</b> Questionnaire; A standardised questionnaire was used to obtain information about frequencies of consumption of specific food items (divided into six categories, from less than once per week to one or more times per day). The participants answered the questionnaire based on their intake before and after the age of 40. The “cured meat” (sausage and ham) category was used to estimate processed meat consumption.</p>	Oesophagus: squamous cell carcinoma	Cured meat consumption			Age, educational levels, ethnicity, source of hospital, smoking, alcohol drinking, areca nut chewing	
			At age 20–40 years, times/week				
			< 1	217			1
			1+	36			1.4 (0.7–2.8)
			At age 40+ years, times/week				
			< 1	235			1
1+	36	1.2 (0.6–2.5)					

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Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
Levi et al. (2004) Switzerland – Canton of Vaud 1992–2002	<p><b>Cases:</b> 138; Incident cases of histology confirmed oesophageal cancer admitted to the University Hospital of Lausanne, part of a wider population of cases from an integrated series of case-control studies of digestive tract and laryngeal neoplasms</p> <p><b>Controls:</b> 660; Hospital-based controls admitted to the same hospital for a wide spectrum of acute, non-neoplastic conditions unrelated to smoking or alcohol consumption and long-term modification of diet</p> <p><b>Exposure assessment method:</b> Questionnaire; Dietary intake quantification was based on a food frequency questionnaire including 79 items and corresponded to the average weekly frequency of consumption during the two years before cancer diagnosis or hospital admission; “Processed meat” = raw ham, boiled ham, salami and sausages</p>	Oesophagus	<p>Processed Meat quartile (times per week)</p> <p>Q1 (&lt; 0.8)</p> <p>Q2 (0.8–1.5)</p> <p>Q3 (1.6–3.2)</p> <p>Q4 (&gt; 3.2)</p> <p>Trend-test p-value: 0.001</p>	<p>15</p> <p>22</p> <p>34</p> <p>67</p>	<p>1</p> <p>1.58 (0.68–3.7)</p> <p>2.33 (1.02–5.33)</p> <p>4.48 (2.05–9.79)</p>	Age, sex, education, tobacco smoking, alcohol drinking, total energy intake, fruit and vegetable intake
Yang et al. (2005) China, Sichuan Province July 2003–July 2004	<p><b>Cases:</b> 185; Cases of oesophageal cancers collected from the Hospital of the Yanting Cancer Research Institute and histologically verified.</p> <p><b>Controls:</b> 185; Controls matched (1–1 matching) on sex, age (within five years), collected from residents of Yanting.</p> <p><b>Exposure assessment method:</b> Questionnaire; Questionnaire included items related to dietary habits over the recent five years. No detail is given as to the definition of “processed meat.”</p>	Oesophagus:	<p>Risk per frequency</p> <p>Processed meat</p> <p>Group 1 (&lt; 1 meal/week)</p> <p>Group 2 (1–3 meals/week)</p> <p>Group 3 (&gt; 3 meals/week)</p> <p>Trend-test p-value: 0.33</p>	<p>64</p> <p>45</p> <p>76</p>	<p>1</p> <p>0.65 (0.3–1.41)</p> <p>0.66 (0.31–1.41)</p>	Family history of oesophageal cancer, occupation, smoking, alcohol drinking, eating hot food, eating speed, vegetables, fruits, pickled vegetables, fresh meat, eggs, tea, type of water supply

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled	
Wu et al. (2007) Los Angeles, USA 1992–1997	<p><b>Cases:</b> 829; All incident cancers were identified by the Los Angeles County Cancer Surveillance Program (CSP), a population-based tumour registry.</p> <p><b>Controls:</b> 1308; Control subjects were individually matched to interviewed case patients on gender, race and date of birth (<math>\pm 5</math> years) in the neighbourhood.</p> <p><b>Exposure assessment method:</b> Questionnaire</p>	Oesophagus adenocarcinoma	Quartile intake (in gram per day)			Age, sex, race, birthplace, education, smoking, BMI (kg/m <sup>2</sup> ), reflux, use of vitamins, and total calories	
		Processed meat	NR	1			
		Q1					
		Q2	NR	1.25 (0.8–2)			
		Q3	NR	1.17 (0.7–1.9)			
		Q4	NR	1.23 (0.7–2.1)			
		Trend-test p-value: 0.55					
		Oesophagus adenocarcinoma	Quartile intake (in gram per day)				Same as above
		Processed meat among subjects infected with <i>H. pylori</i>	NR	1			
		Q1					
Q2	NR	1.51 (0.6–3.7)					
Q3	NR	0.79 (0.3–2)					
Q4	NR	1.15 (0.4–3)					
Trend-test p-value: 0.92							



**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
Navarro Silvera et al. (2008) United States of America – Connecticut, New Jersey and western Washington state 1993–early 1995	<p><b>Cases:</b> 206 282, 255, 352; Incident cases of oesophageal cancer (206 cases of squamous cell cancer and 282 cases of adenocarcinoma) and stomach adenocarcinoma (255 cases of cardia and 352 cases of non-cardia). In fact, this population is part of a larger population of cases containing also cases of cardia and non-cardia gastric adenocarcinoma. Oesophageal adenocarcinomas and gastric cardia adenocarcinoma were considered as the “target cases” whereas oesophageal squamous cell carcinoma and non-cardia gastric adenocarcinoma cases were considered as a “comparison case group” frequency-matched to the “target group.”</p> <p><b>Controls:</b> 687; Population-based controls frequency-matched to the expected distribution of the “target cases” (i.e. cases of oesophageal adenocarcinoma and gastric cardia adenocarcinoma) by five-year age group, sex (in New Jersey and Washington state), “race” (in New Jersey), and study site. Controls aged 30–64 were identified by the random digit dialing method and controls aged 65–79 were identified by Health Care Financing Administration rosters.</p> <p><b>Exposure assessment method:</b> Questionnaire; An expanded version of a food frequency questionnaire developed and validated by investigators at the Fred Hutchinson Cancer Research Center, was used to assess usual food consumption in the period 3–5 years before diagnosis (cases) or interview (controls). Processed meat was defined as “High-nitrite meats” = Smoked turkey lunchmeat; cured, smoked ham lunchmeat; bologna; salami; hot dogs; sausage, not including breakfast sausage; bacon; breakfast sausage.</p>	Oesophagus Squamous cell carcinoma Adenocarcinoma	High-nitrite meats For an increasing intake of one serving/day	NR NR	1.62 (0.91–2.9) 1.34 (0.84–2.15)	Sex, site, age, “race,” proxy status, income, education, usual body mass index, cigarette/day, consumption of beer, consumption of beer, wine and liquor each, energy intake

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
Sapkota et al. (2008) the Russian Federation (Moscow); Romania (Bucarest); Poland (Lodz); Hungary (Budapest); Slovakia (Banska Bystrica); Czech Republic (Prague, Olomouc) August 1999–January 2003	<p><b>Cases:</b> 187; Incident cases of histologically confirmed oesophageal cancer (squamous cell carcinoma). In fact, the original study population consisted of patients newly diagnosed with UADT cancers (oral/pharyngeal, laryngeal and oesophageal cancers).</p> <p><b>Controls:</b> 1110; Hospital-based controls who were admitted to the same hospital as cases for conditions unrelated to smoking or alcohol (but 24% were hospitalised for diseases of the digestive system). In the Russian Federation, controls were frequency-matched to the cases by age, sex, and referral or residence area.</p> <p><b>Exposure assessment method:</b> Questionnaire; Intake frequency information was gathered for 23 different food items (chosen by consensus during the planning stage by the investigators and further validated during the pilot stage by asking participants to name food items not already specified). The questionnaire was repeated for two time periods (to capture possible shifts in dietary patterns before and after political changes): dietary intake for the period before political changes in 1989 (1991 in the Russian Federation) and dietary intake for the year before the interview date. Lifetime food frequencies were calculated by a weighted average of intake for the two time periods. Frequencies of intake of related foods were combined across food groups and categorized based on tertile cut-off points defined by consumption among controls. “Processed meat” = ham, salami, sausages.</p>	Oesophagus Squamous cell carcinoma	Ham, salami, sausage Low (< 1/month)  Medium (< 1/week)  High (1 ≤ /week)  Trend-test p-value: 0.86	11  18  158	1  1.16 (0.46–2.92)  1.12 (0.52–2.41)	Age, country, gender, tobacco (pack-years), education, BMI, frequency of alcohol consumption, tertiles of total vegetable consumption, tertiles of total fruit consumption

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Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
Chen et al. (2009) Taiwan, China 1996–2005	<b>Cases:</b> 343; Incident histologically confirmed cases of squamous cell carcinoma of the oesophagus (ICD-9 code 150) recruited from three medical centres (National Taiwan, China University Hospital, northern Taiwan, China; Kaohsiung Medical University Hospital and Kaohsiung Veterans General Hospital, southern Taiwan, China). <b>Controls:</b> 755; Hospital-based controls matched on age (+/- 4 years) and hospital. <b>Exposure assessment method:</b> Questionnaire; Dietary intake (frequency) was assessed through a standardised questionnaire. Cured meat = sausage and ham.	Oesophagus Squamous cell carcinoma	Men – Cured meat ≤ 1 time/week	285	1	Age, Educational levels, Ethnicity, Source of hospital, Smoking, alcohol drinking, Areca nut chewing
			≥ 1 time/week	35	0.8 (0.4–1.4)	
		Oesophagus Squamous cell carcinoma – Upper third	≤ 1 time/week	65	1	Same as above
			≥ 1 time/week	7	0.6 (0.2–1.6)	
		Squamous cell carcinoma - Middle third	≤ 1 time/week	131	1	Same as above
			≥ 1 time/week	20	0.9 (0.5–1.9)	
Squamous cell carcinoma – Lower third	≤ 1 time/week	89	1	Same as above		
	≥ 1 time/week	8	0.6 (0.2–1.4)			
O’Doherty et al. (2011) FINBAR study (Northern Ireland and the Republic of Ireland) March 2002–July 2005	<b>Cases:</b> 224; Histologically confirmed adenocarcinoma; with verification that the tumour was located in the oesophagus. in situ cancers were not included <b>Controls:</b> 256; Without a history of esophageal or other gastrointestinal cancer, or a known diagnosis of BE, selected at random from general practitioner lists in Northern Ireland and the Dublin and Cork areas <b>Exposure assessment method:</b> Questionnaire; FFQ of EPIC, 101 items relating to a period 5-year before interview (pre-morbid diet) was collected	Oesophagus Adenocarcinoma	risk by intake level			Age at interview, sex, smoking status, body mass index 5 years before interview date, job type, education, energy intake, fruit, vegetable, alcohol, <i>Helicobacter pylori</i> infection, nonsteroidal antiinflammatory drug use 5 years before interview date, gastroesophageal reflux symptoms, location, intake of other types of meat
			Processed meat (median for controls)	43	1	
			11.1 g/day			
			31.3 g/day	61	1.39 (0.64–3.04)	
			53.3 g/day	45	1.07 (0.5–2.27)	
96.1 g/day	72	1.41 (0.67–2.95)				
		Trend-test p-value: 0.49				

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Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled	
Song et al. (2012) China – Yanting County (Sichuan Province) January 2008–May 2010	<p><b>Cases:</b> 254; Incident+prevalent cases of histologically confirmed primary squamous cell carcinoma of the oesophagus (ICD-10 codes 15.3–15.5) recruited from the Yanting Tumor Hospital. Mean age 59.9.</p> <p><b>Controls:</b> 254; Community-based controls who participated in a screening programme to detect early oesophageal cancer in high-risk areas, did not have cancer of any site and were not related to the cases. Controls were matched to the cases on age (+/- 5 years) and gender. Mean age 58.8.</p> <p><b>Exposure assessment method:</b> Questionnaire; Dietary intake was assessed through a FFQ first introduced by the National Institute of cancer and modified based on the local dietary habits. Details regarding frequency and amount of different food items consumed five years before the diagnosis (or the interview for the controls) were collected.</p>	Oesophagus Squamous cell carcinoma	Intake frequency of salted meat			Age, Smoking, Alcohol drinking, Fruit and vegetable consumption, Family history of oesophageal cancer, Annual per capita income, Preserved vegetable consumption, Pickled vegetable consumption, Age (Conditional), Gender (Conditional)	
		< 1 time/month	46	1			
		< 1 time/week	81	1.79 (0.74–4.33)			
		≥ 1 time/week	126	2.57 (1.02–6.43)			
		Trend-test p-value: 0.05					
		Oesophagus Squamous cell carcinoma	Increasing intake of salted meat by sex (Continuous)				Same as above
	Men	NR	1.41 (0.84–2.36)				
	Women	NR	1.47 (0.65–3.32)				
	Oesophagus Squamous cell carcinoma	Increasing intake of salted meat by age (continuous)			Same as above		
	< 65 years	NR	1.55 (0.89–2.71)				
	≥ 65 years	NR	0.97 (0.31–3.09)				

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Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
Ward et al. (2012) United States of America (66 counties in eastern Nebraska) July 1, 1988–June 30, 1993	<b>Cases:</b> 124 for oesophagus and 154 for stomach; Incident cases of adenocarcinoma of the oesophagus (ICD-O codes 150, 151) and stomach identified from the Nebraska Cancer Registry and confirmed by histological review. <b>Controls:</b> 449; Controls randomly selected from a previous population-based case-control study in the same geographic region, matched by race, age, gender, and vital status. <b>Exposure assessment method:</b> Questionnaire; Dietary information was obtained using a short version of the Health Habits and History Questionnaire (HHHQ). "Processed meat" = bacon, sausage, luncheon meats, hot dogs, ham, and home-cured meat.	Oesophagus:	Processed meat			Adjusted for year of birth, gender, cigarettes/day, (none, < 30/day, 30+/day), quartiles of body mass index, continuous intake of retinoic acid, folate, riboflavin, zinc, carbohydrate, protein, total calories.
			All	20	1	
			Q1 ( $\leq 16.1$ g/day)			
			Q2 (16.2–29.6 g/day)	26	0.81 (0.38–1.72)	
			Q3 (29.7–52.3 g/day)	31	1.07 (0.52–2.21)	
			Q4 ( $> 52.3$ g/day)	47	1.4 (0.62–3.15)	
OR per 10 g/day	NR	1.06 (0.97–1.17)				
			Trend-test p-value: 0.23			
De Stefani et al. (2014b) Uruguay 1990–2005	<b>Cases:</b> 876; Newly diagnosed and microscopically validated cases of squamous cell carcinoma of the oesophagus, drawn from the four major public health hospitals. <b>Controls:</b> 1492; In the same time period and in the same hospitals, all patients afflicted by non-neoplastic conditions, not related with tobacco smoking or alcohol drinking were eligible for the study. <b>Exposure assessment method:</b> Questionnaire; FFQ: Processed meat was replaced by salted meat and other cured meats (bacon, sausage, mortadella, salami, saucisson, frankfurter, and ham)	Oesophagus Squamous cell carcinoma	Risk by intake level			Age, sex, residence, education, tobacco smoking (in pack years), alcohol drinking, mate consumption, total energy, total vegetable and fruit intake, and red meat consumption
			Total processed meat $\leq 4.1$	103	1	
			4.2–17.9	173	1.47 (1.07–2.02)	
			18.0–53.8	265	2.18 (1.62–2.93)	
		$\geq 53.9$	335	2.3 (1.72–3.07)		
		Continuous	876	1.11 (1.08–1.15)		
		Oesophagus Squamous cell carcinoma	Salted meat; 0	537	1	Same as above, and other cured meats
			0.1–8.9	104	1.53 (1.12–2.07)	
9.0–25.7	91		2.84 (1.95–4.14)			
25.8+	144		3.82 (2.74–5.33)			
		Continuous	876	1.13 (1.1–1.16)		

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
		Oesophagus Squamous cell carcinoma: Upper third oesophagus	Processed meat			Same as above
			G1	NR	1	
			G2	NR	1.57 (1.16–2.12)	
			G3	NR	1.94 (1.45–2.6)	
			G4	NR	1.65 (1.22–2.22)	
			Trend-test p-value: 0.09			
		Oesophagus Squamous cell carcinoma: Upper third oesophagus	Salted meat			Same as above
			G1	NR	1	
			G2	NR	0.29 (0.07–1.3)	
			G3	NR	1.7 (0.65–4.45)	
			G4	NR	2.03 (0.86–4.83)	
			Trend-test p-value: 0.17			
		Oesophagus Squamous cell carcinoma: Upper third oesophagus	Other cured meat			Same as above
			G1	NR	1	
			G2	NR	1.62 (0.72–3.64)	
			G3	NR	1.43 (0.62–3.3)	
			G4	NR	1.7 (0.77–3.75)	
			Trend-test p-value: 0.27			
		Oesophagus Squamous cell carcinoma Middle third oesophagus	Processed meat			Same as above
			G1	NR	1	
			G2	NR	1.25 (0.76–2.03)	
			G3	NR	1.6 (1–2.54)	
			G4	NR	1.61 (1.03–2.52)	
			Trend-test p-value: 0.02			

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
		Oesophagus Squamous cell carcinoma: Middle third oesophagus	Salted meat			Same as above
			G1	NR	1	
			G2	NR	2.49 (1.61–3.84)	
			G3	NR	3.49 (2.08–5.84)	
			G4	NR	2.96 (1.8–4.85)	
			Trend-test p-value: 0.0001			
		Oesophagus Squamous cell carcinoma: Middle third oesophagus	Other cured meats			Same as above
			G1	NR	1	
			G2	NR	1.38 (0.88–2.17)	
			G3	NR	1.46 (0.94–2.28)	
			G4	NR	1.09 (0.68–1.74)	
			Trend-test p-value: 0.74			
		Oesophagus Squamous cell carcinoma: Lower third oesophagus	Processed meats			Same as above
			G1	NR	1	
			G2	NR	1.01 (0.52–1.98)	
			G3	NR	1.45 (0.78–2.7)	
			G4	NR	1.51 (0.83–2.76)	
			Trend-test p-value: 0.07			
		Oesophagus Squamous cell carcinoma: Lower third oesophagus	Salted meat			Same as above
			G1	NR	1	
			G2	NR	1.5 (0.84–2.68)	
			G3	NR	2.03 (0.99–4.12)	
			G4	NR	1.81 (0.92–3.55)	
			Trend-test p-value: 0.01			

**Table 2.8.4 Case-control studies: Processed meat and cancer of the oesophagus (web only)**

Reference, location enrolment/follow-up period, study design	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled
		Oesophagus Squamous cell carcinoma: Lower third oesophagus	Other cured meat G1 G2 G3 G4 Trend-test p-value: 0.02	NR NR NR NR	1 1.42 (0.75–2.72) 1.49 (0.78–2.84) 2.12 (1.12–4)	Same as above
Lin et al. (2015) Yanting County, located in the South-western China June 2011–May 2013	<b>Cases:</b> 942; Cases from a major local tumour hospital, which is the only esophageal carcinoma specialty hospital in the county <b>Controls:</b> 942; Population-based control selected with the multistage sampling method from the local residents who had lived in the county for at least 15 years. <b>Exposure assessment method:</b> Questionnaire; A food frequency questionnaire (FFQ) with 56 food items, based on local diets and food availability, which covered more than 97.5% of typical foods in the region	Oesophagus Squamous cell carcinoma: cases with a pathologic confirmation	risk by frequency, amount each time, mean intake Salted meat Frequency; never < 1 time/wk 1–3 ≥ 4 Intake amount each time; never < 1/4 bowl 1/4–1/2 > 1/2 Mean intake,g/wk; never Q1 (16.3–8.1) Q2 (56.5–25.8) Q3 (134.0–48.7) Q4 (342.5–132.8)	45 280 496 121 45 70 579 248 45 225 206 186 280	1 1.77 (1.16–2.69) 2.4 (1.58–3.63) 7.06 (4.07–12.23) 1 1.51 (0.91–2.49) 1.91 (1.27–2.88) 7.28 (4.5–11.77) 1 1.77 (1.15–2.74) 1.78 (1.16–2.74) 2.37 (1.51–3.72) 5.52 (3.49–8.74)	Sex, age, marital status, household income, BMI, family history of cancer, intake of pickled and preserved vegetables, fresh vegetables, fresh fruit, total energy, smoking, alcohol consumption





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