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RED MEAT AND PROCESSED MEAT

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IARC MONOGRAPHS ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS

Table 2.8.1 Cohort studies: Red 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
Cross et al. (2011) United States of America (California, Florida, Louisiana, New Jersey, North Carolina, Pennsylvania + two metropolitan areas: Atlanta, Georgia and Detroit, Michigan) End of 2006	494 979; Men and women, aged 5–71 years, enrolled in 1995–1996. The following individuals were excluded: duplicates, participants who died or moved before the baseline questionnaire was received or withdrew from the study, who did not return the baseline questionnaire, whose baseline questionnaire was filled in by someone else on their behalf, who had prevalent cancer according to the cancer registry or self-report, those with extreme daily total energy intake. **Exposure assessment method:** Questionnaire; Dietary intake of various food items was assessed through a 124-item food frequency questionnaire (usual frequency of consumption and portion size information of foods over the previous twelve months). Portion sizes and daily nutrient intakes were calculated from the 1994–1996 US Department of Agriculture's Continuing Survey of Food Intakes by Individuals. "Red Meat" = all types of beef, pork and lamb, including bacon, beef, cold cuts, ham, hamburger, hotdogs, liver, pork, sausage and steak. Meat added to complex food mixtures, such as pizza, chili, lasagna, and stew, contributed to the relevant meat type.	Oesophagus Squamous cell carcinoma: (ICD-O-3 C15.0–C15.9); (histology codes 8050–8076)	Red meat, Quintile median (μg/1000kcals)			Age, sex, body mass index, education, ethnicity, tobacco smoking, alcohol drinking, usual physical activity at work, vigorous physical activity, daily intake of fruit, daily intake of vegetables, daily intake of saturated fat, daily intake of calories
			Q1 (10.0)	28	1	
			Q2 (21.9)	35	1.18 (0.71–1.96)	
			Q3 (32.2)	42	1.34 (0.8–2.22)	
			Q4 (44.1)	41	1.19 (0.7–2.01)	
			Q5 (64.8)	69	1.79 (1.07–3.01)	
			All – Red Meat – Continuous (per 10 g/1000kcals)	NR	1.06 (1–1.13)	
			Trend-test p-value: 0.019			
		Oesophagus Adenocarcinoma: (ICD-O-3 C15.0–C15.9); (histology codes 8140, 8141, 8190–8231, 8260–8263, 8310, 8430, 8480–8490, 8560, 8570–8572)	Red meat, Quintile median (μg/1000kcals)			Same as above
			Q1 (10.0)	74	1	
			Q2 (21.9)	112	1.18 (0.87–1.59)	
			Q3 (32.2)	113	1 (0.74–1.37)	
			Q4 (44.1)	154	1.17 (0.87–1.59)	
			Q5 (64.8)	177	1.15 (0.84–1.57)	
			All – Red Meat – Continuous (per 10 g/1000kcals)	NR	1.01 (0.98–1.06)	
			Trend-test p-value: 0.492			

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	A risk factor questionnaire sent six months later to a subcohort of 303 165 persons elicited detailed information on meat intake and cooking preferences.	Oesophagus Squamous cell carcinoma: (ICD-O-3 C15.0–C15.9) – (histology codes 8050–8076)	Heme Iron, Quintile median (µg/1000kcals)			Same as above
			Q1 (48.8)	17	1	
			Q2 (102.9)	25	1.38 (0.74–2.58)	
			Q3 (154.2)	31	1.6 (0.87–2.96)	
			Q4 (218.7)	27	1.33 (0.7–2.53)	
			Q5 (347.7)	28	1.25 (0.64–2.42)	
			All – Heme Iron – Continuous (per 100 µg/1000kcals)	NR	1.02 (0.89–1.17)	
			Trend-test p-value: 0.944			
		Oesophagus Adenocarcinoma: (ICD-O-3 C15.0–C15.9); (histology codes 8140, 8141, 8190–8231, 8260–8263, 8310, 8430, 8480–8490, 8560, 8570–8572)	Heme Iron, Quintile median (µg/1000kcals)			Same as above
			Q1 (48.8)	39	1	
			Q2 (102.9)	55	1.12 (0.74–1.7)	
			Q3 (154.2)	81	1.4 (0.94–2.07)	
			Q4 (218.7)	88	1.32 (0.89–1.97)	
			Q5 (347.7)	114	1.47 (0.99–2.2)	
			All – Heme Iron – Continuous (per 100 µg/1000kcals)	NR	1.04 (0.96–1.12)	
			Trend-test p-value: 0.063			

Table 2.8.1 Cohort studies: Red 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
Keszei et al. (2012) Netherland 1986–2002	120 852 were recruited and finally, 3923 subcohort members were used in the analysis (Case-cohort design); The sample was selected from 204 municipal population registries throughout the Netherlands by gender-stratified random sampling. **Exposure assessment method:** Questionnaire; FFQ	Oesophagus: oesophagus carcinomas included squamous cell carcinomas (ESCC) C15, histology codes: 8050–8076, and adenocarcinomas (EAC) C15, histology codes: 8140, 8141, 8190–8231, 8260–8263, 8310, 8430, 8480–8490, 8560, and 8570–8572.	Risk by quintile			Adjusted for age (years), smoking status (current versus non-current smoker), years of cigarette smoking, number of cigarettes smoked per day, total energy intake (kjoules/day), body mass index (categories: < 20, 20–24.9, 25–29.9, and $\geq$ 30 kg/m2), alcohol intake (grams/day), vegetable intake (grams/day), fruit intake (grams/day), levels of education (four categories), and non-occupational physical activity (four categories). For EAC, models are additionally adjusted for use of lower oesophageal sphincter relaxing medications.
			ESCC, men Q1	6	1	
			Q2	12	1.86 (0.65–5.33)	
			Q3	13	1.83 (0.64–5.28)	
			Q4	11	2.15 (0.76–6.11)	
			Q5	17	2.66 (0.94–7.48)	
			Trend-test p-value: 0.06			
		EAC	men, Q1	21	1	Same as above
			Q2	23	1.06 (0.56–2.03)	
			Q3	22	0.98 (0.52–1.85)	
			Q4	32	1.37 (0.76–2.47)	
			Q5	16	0.57 (0.28–1.19)	
			Trend-test p-value: 0.2			

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		ESCC	women, T1	16	1	Same as above
			T2	15	0.84 (0.39–1.84)	
			T3	17	0.87 (0.42–1.79)	
			Trend-test p-value: 0.73			
		EAC	women, T1	9	1	Same as above
			T2	9	0.74 (0.29–1.94)	
			T3	13	1.09 (0.44–2.75)	
			Trend-test p-value: 0.76			
Jakszyn et al. (2013) the European Prospective Investigation into Cancer and Nutrition (EPIC) 1992–11 years	472 538 participants. A total of 521 457 subjects (153,447men), aged mostly 35–70 years in 23 centres from 10 European countries **Exposure assessment method:** Questionnaire; Models for the continuous variables of meat (unprocessed red and processed)(for 25 g/2,000 kcal)	Oesophagus Adenocarcinoma: (ICD10)	Red meat (25 g/200kcal)			Sex, Smoking status (never, former, smoker and unknown), Time since quitting smoking (y), Number of cigarettes (cig/d), Body mass index (BMI)(kg/m2), Total energy intake(kcal/day), Fresh fruits (g/2,000 kcal), Vegetables intake (g/2,000 kcal), Educational levels
			Tertile 1	36	1	
			Tertile 2	40	0.91 (0.57–1.47)	
			Tertile 3	61	1 (0.6–1.66)	
			Trend-test p-value: 0.911			
		Oesophagus Adenocarcinoma: (ICD10)	Heme Iron (mg/2000kcal)			Same as above
			Tertile 1	43	1	
			Tertile 2	34	0.96 (0.6–1.53)	
			Tertile 3	59	1.67 (1.05–2.68)	
			Trend-test p-value: 0.048			

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