



**RED MEAT AND  
PROCESSED MEAT**

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OF CARCINOGENIC RISKS  
TO HUMANS**

**Table 2.4.2 Cohort studies: Processed meat and cancer of the pancreas (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
Stolzenberg-Solomon et al. (2002) Finland 1985–1997	27 111; Male smokers aged 50–69 years <b>Exposure assessment method:</b> Questionnaire; 200 item dietary history questionnaire	Pancreas	Processed meat (g/day)			Age, smoking, total energy
			≤ 35.2	NR	1	
			> 35.2 ≤ 52.2	NR	0.76 (0.47–1.23)	
			> 52.2 ≤ 71.5	NR	0.65 (0.39–1.08)	
			> 71.5 ≤ 100.6	NR	0.97 (0.61–1.54)	
			> 100.6	NR	1.04 (0.66–1.65)	
			Trend-test p-value: 0.63			
Michaud et al. (2003) USA 1980–1998	88 802; US female registered nurses aged 30–55 <b>Exposure assessment method:</b> Questionnaire; FFQ	Pancreas	Processed meat (frequency)			Smoking, BMI, diabetes, total energy intake, physical activity, height, menopausal status
			< 3/month	71	1	
			1/week	38	0.72 (0.48–1.07)	
			2–4/week	27	0.78 (0.5–1.22)	
			≥ 5/week	42	1.28 (0.86–1.92)	
			Trend-test p-value: 0.1			
Nöthlings et al. (2005) USA 1993–2001	190 545; African-American, Latino, Japanese-American, Native Hawaiian, and Caucasian residents of Hawaii and California age 45–75 <b>Exposure assessment method:</b> Questionnaire; Quantitative FFQ	Pancreas	Processed meat (quintile median g/1000Kcal/day)			Sex, time on study, age at cohort entry, ethnicity, history of diabetes mellitus, familial history of pancreatic cancer, smoking status, and energy intake.
			1.7	59	1	
			4.5	101	1.59 (1.28–1.97)	
			7.3	116	1.8 (1.46–2.21)	
			10.8	96	1.47 (1.18–1.82)	
			18.1	110	1.68 (1.35–2.07)	
			Trend-test p-value: 0.01			

**Table 2.4.2 Cohort studies: Processed meat and cancer of the pancreas (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	
Larsson et al. (2006) Sweden 1987–2004	61 433; Women born 1914–1948 and residing 2 Swedish counties <b>Exposure assessment method:</b> Questionnaire; FFQ	Pancreas	Processed meat at baseline (servings/wk)			Age, BMI, smoking, alcohol, education, total energy, energy-adjusted folate, red meat, process meat, poultry, and egg	
			< 1.5	77	1		
			1.5 < 2.5	24	0.7 (0.43–1.12)		
			2.5 < 4.0	32	0.74 (0.47–1.15)		
			≥ 4.0	39	1 (0.65–1.55)		
				Trend-test p-value: 0.95			
		Pancreas	Processed meat, updated average consumption (servings/wk)				Same as above
			< 1.5	58	1		
			1.5 < 2.5	29	0.8 (0.52–1.27)		
			2.5 < 4.0	35	0.77 (0.5–1.18)		
≥ 4.0	40		0.94 (0.61–1.44)				
		Trend-test p-value: 0.7					
Lin et al. (2006) Japan 1988–1999	110 792 (46 465 men and 64 327 women); Japanese residing in 45 areas throughout Japan <b>Exposure assessment method:</b> Questionnaire; FFQ	Pancreas	Ham and sausage (frequency)			Age, area, and pack-years of smoking	
			<b>Men:</b> 0–2/month	55	1		
			1–4/wk	51	1.08 (0.72–1.6)		
			Almost every day	7	1.82 (0.62–4.26)		
					Trend-test p-value: 0.34		
		Pancreas	Ham and sausage (frequency)				Age, area, and pack-years of smoking
			<b>Women:</b> 0–2/month	59	1		
			1–4/wk	58	1.14 (0.78–1.65)		
			Almost every day	3	0.93 (0.29–2.99)		
					Trend-test p-value: 0.63		

**Table 2.4.2 Cohort studies: Processed meat and cancer of the pancreas (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
Heinen et al. (2009) Netherlands 1986–1999	120 852; Men & women age 55–69 years at enrollment <b>Exposure assessment method:</b> Questionnaire; FFQ	Pancreas: ICDO-3	Processed meat (quintile g/day)			Sex, age, energy intake, smoking, alcohol, diabetes, hypertension, vegetable & fruit intake
			Q1	73	1	
			Q2	69	0.95 (0.67–1.35)	
			Q3	63	0.83 (0.58–1.19)	
			Q4	75	0.99 (0.7–1.4)	
			Q5	70	0.93 (0.65–1.35)	
			Trend-test p-value: 0.97			
Anderson et al. (2012) USA 1993–2006	62 581; Women & men age 55–74 <b>Exposure assessment method:</b> Questionnaire; Food frequency questionnaire (170 questions)	Pancreas	Bacon and sausage			Age, sex, education, diabetes, dietary fat intake, cigarette smoking history, race
			Don't eat or lesser degree of doneness	NR	1	
			Well done, crisp or charred	NR	0.99 (0.73–1.35)	
Rohrmann et al. (2013) Europe 1992–2008	477 202; EPIC participants from 10 European countries <b>Exposure assessment method:</b> Questionnaire	Pancreas	Processed meat intake (g/day)			Area, sex, age, height, weight, physical activity index, smoking, education, history of diabetes mellitus, total energy
			0 < 10	181	1	
			10 < 20	167	0.98 (0.78–1.23)	
			20 < 40	257	0.93 (0.75–1.15)	
			40+	260	0.8 (0.63–1.02)	
			Per 50 g observed	865	0.96 (0.83–1.09)	
Per 50 g calibrated	865	0.93 (0.71–1.23)				

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Jiao et al. (2015) USA 1995–2006	567 169; Members of the American Association of Retired Persons (AARP) age 50–71 in 6 states <b>Exposure assessment method:</b> Questionnaire; 124-item 12-month FFQ	Pancreas	Processed meat intake (g/1000kcal) <b>Men:</b> 0–6.4 6.5–12.7 12.8–21.9 22.0–37.5 37.6–602.2 Trend-test p-value: 0.28	232 289 284 316 286	1 1.21 (1.01–1.44) 1.21 (1.01–1.45) 1.25 (1.04–1.5) 1.03 (0.92–1.37)	Age, race, education, diabetes, smoking, first degree family history of cancer, BMI, alcohol consumption, carbohydrate intake, saturated fat

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