Table 2.9.1 Cohort studies: Red meat and other cancers (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
Zheng et al. (1995) Iowa 1986; follow-up 7 years Cohort	23 070 cohort/ 216 endometrial cancer cases; Postmenopausal women with no history of cancer or hysterectomy. **Exposure assessment method:** Questionnaire; Women filled in a validated 127-item FFQ. Red meat not defined.	Endometrium	Tertiles of red meat intake			Age, age at menopause, parity, postmenopausal hormone use, and total energy intake.
			T1	NR	1	
			T2	NR	1	
			T3	NR	1.1	
Chiu et al. (1996) Iowa, United States 1986, 7 years of follow-up Cohort	35 156; Women aged 55 to 69 years from the Iowa Women's Health Study, randomly selected from the State of Iowa Automobile driver's license list **Exposure assessment method:** Questionnaire; 126-item validated food frequency questionnaire from Willet. The red meat group included: bacon, hotdogs, processed meat, liver, beef stew, hamburger, and beef as main dish (no specification of other pork meat and lamb).	NHL: Non-Hodgkin's lymphoma (ICD-O)	Tertiles of red meat consumption (servings/month)			Age (continuous), marital status (current, former, or never), residence (farm or nonfarm), transfusion history (ever vs never), and total energy intake (continuous)
			T1 (< 22 servings/month)	30	1	
			T2 (22–36 servings/month)	28	1.11 (0.64–1.91)	
			T3 (> 36 servings/month)	46	1.98 (1.13–3.47)	
			Trend-test p-value: 0.02			
		NHL: Non-Hodgkin's lymphoma (ICD-O)	Hamburger – level of intake			Same as above
			< 4 servings/month	16	1	
			4 servings/month	43	2.21 (1.19–4.13)	
			> 4 servings/month	45	2.35 (1.23–4.48)	
			Trend-test p-value: 0.02			
Zhang et al. (1999) US 1980; 14 years of follow-up Cohort	88 410/199 cases; Female registered nurses aged 34–60 years living in 11 states of the United States **Exposure assessment method:** Questionnaire; Total red meat included processed meat and was defined as the sum of the frequencies for six categories from the FFQ: beef, pork, or lamb as main dish (68% of total red meat); beef, pork or lamb as a sandwich or	NHL: Non-Hodgkin's lymphoma	Quintiles of total red meat consumption (including processed meat)			Age, Total energy, length of follow-up, Geographic region, Cigarette smoking, Height
			Q1	NR	1	
			Q2	NR	0.9	
			Q3	NR	1.3	
			Q4	NR	1	
			Q5	NR	1.3 (0.8–2.2)	

Table 2.9.1 Cohort studies: Red meat and other cancers (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
	mixed dish; hamburgers; hotdogs; processed meats; and bacon and took into account the gram weights of servings. Beef, pork, or lamb as main dish was also analysed and reported separately. Finally the cooking methods of beef, pork or lamb as main dish were investigated.		Trend-test p-value: 0.25			
		NHL: Non-Hodgkin's lymphoma	Frequencies of beef, pork, or lamb as a main dish (68% of total red meat, and taking into account the grams of weight of servings)			Same as above
			< 1/mo – 1–3/mo	26	1	
			1/week	51	1 (0.6–1.5)	
			2–4/week	82	1.4 (0.9–2.2)	
			5–6/week	23	1.7 (0.9–3.2)	
			1/day	17	2.2 (1.1–4.4)	
			Trend-test p-value: 0.002			
		NHL: Non-Hodgkin's lymphoma	Frequencies of broiled beef, pork, or lamb during main dish (68% of total red meat, and taking into account the grams of weight of servings)			Same as above
			< 1/month	27	1	
			1–3/month	37	1.5 (0.9–2.4)	
			1/week	30	1.6 (1–2.7)	
			≥ 2–4/week	19	1.8 (1–3.3)	
			Trend-test p-value: 0.09			
		NHL: Non-Hodgkin's lymphoma	Frequencies of barbecued beef, pork, or lamb consumption as a main dish (68% of total red meat, and taking into account the grams of weight of servings)			Same as above
			< 1/month	55	1	
			1–3/month	32	1.2 (0.8–1.9)	
			1/week	25	1.5 (0.9–2.4)	
			Trend-test p-value: 0.13			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
		NHL: Non-Hodgkin's lymphoma	Frequencies of roasted beef, pork, or lamb consumption as a main dish (68% of total red meat, and taking into account the grams of weight of servings)			Same as above
			< 1/month	30	1	
			1–3/month	47	0.9 (0.6–1.5)	
			1/week	37	0.9 (0.5–1.4)	
			Trend-test p-value: 0.64			
		NHL: Non-Hodgkin's lymphoma	Frequencies of pan-fried beef, pork, or lamb consumption as a main dish (68% of total red meat, and taking into account the grams of weight of servings)			Same as above
			< 1/month	59	1	
			1–3/month	29	1.4 (0.9–2.2)	
			1/week	22	1 (0.6–1.7)	
			Trend-test p-value: 0.89			
		NHL: Non-Hodgkin's lymphoma	Frequencies of boiled or stewed beef, pork, or lamb consumption as a main dish (68% of total red meat, and taking into account the grams of weight of servings)			Same as above
			< 1/month	52	1	
			1–3/month	42	1.3 (0.9–2)	
			1/week	17	1 (0.5–1.7)	
			Trend-test p-value: 0.94			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
Bertone et al. (2002) USA 1980; Follow-up 1980– 1996 Cohort	80 258/ 301 cases of confirmed invasive epithelial ovarian cancer; US female aged 30–55 years registered nurses who completed the baseline FFQ in 1980, and had no diagnosis of cancer, bilateral oophorectomy, or pelvic irradiation. **Exposure assessment method:** Questionnaire; food frequency questionnaire (FFQ). A 61-item questionnaire was used for baseline assessment of diet in1980, whereas the FFQ used in 1984, 1986, and 1990 was expanded to include 131 foods. Red meat (beef, pork, lamb).	Ovary: Invasive epithelial ovarian cancer	Quintiles of red meat (beef, pork, lamb) intake as main dish, frequency			Age, parity, age at menarche, menopausal status/HRT use, tubal ligation, smoking status
			Q1: 1–3/month	83	1	
			Q2: 1/week	150	1.17 (0.91–1.51)	
			Q3–Q5: 2/week–≥ 1/day	52	1.3 (0.93–1.82)	
			Trend-test p-value: 0.16			
		Ovary: Invasive epithelial ovarian cancer	Quintiles of red meat (beef, pork, lamb) intake as mixed dish, frequency			Same as above
			Q1: < 1/month	71	1	
			Q2:1–3/month	91	0.89 (0.66–1.19)	
			Q3: 1/week	88	0.67 (0.49–0.9)	
			Q4–Q5: 2/week–≥ 1/day	33	0.87 (0.58–1.31)	
			Trend-test p-value: 0.05			
		Ovary: Invasive epithelial ovarian cancer	Quintiles of hamburger intake frequency			Same as above
			Q1: < 1/month	61	1	
			Q2: 1–3/month	145	1.09 (0.83–1.44)	
			Q3: 1/week–≥ 1/day	79	0.86 (0.63–1.17)	
			Trend-test p-value: 0.07			

Table 2.9.1 Cohort studies: Red meat and other cancers (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 and Wolk (2005) Sweden, Uppsala and Västmanland counties 1987–2004; average follow-up 14.7 years Cohort	61 057/ 288 cases; All women aged 40–76 years, living in the 2 counties. Energy intake within 3 SD from the loge-transformed mean in the cohort. No previous cancer diagnosis, no bilateral oophorectomy, or a hysterectomy with unknown number of ovaries removed at baseline. **Exposure assessment method:** Questionnaire; Validated FFQ. Swedish Mammography Cohort with follow-up from 1987 to 2004 and dietary assessments in 1987 and 1997. Red meat (beef, pork) may include processed meat.	Ovary: Ephitelial ovarian cancer	Red meat consumption – beef or pork as a main dish: servings/week (median)			Age, BMI, education, parity, use of oral contraceptives and postmenopausal hormones, total energy intake, consumption of fruits, vegetables, and dairy products.
			< 2 (1.5)	91	1	
			2– < 3 (2.5)	55	0.86 (0.62–1.21)	
			3– < 4 (3.0)	96	1.31 (0.94–1.82)	
			> 4 (5.0)	46	1.01 (0.7–1.46)	
			Trend-test p-value: 0.27			
Michaud et al. (2006) USA 1986/1976 Cohort	149 991/ 808 cases (504 in men, 304 in women); Participants of the HPFS study are dentists (57.6%), veterinarians (19.6%), pharmacists (8.1%), optometrists (7.3%), osteopathic physicians (4.3%), and podiatrists (3.1%).The NHS includes 121 700 female registered nurses aged 30–55 y responded to a mailed questionnaire. **Exposure assessment method:** Questionnaire; Including the health professionals follow-up study (HPFS, 51 529 men) and the Nurses Health Study (NHS, 98 462 women) was based om long-term diet (repeated validated food-frequency questionnaires over time). Red meat (beef, pork, lamb).	Urinary bladder	Frequency of red meat (beef, pork, lamb as main dish) intake among men			Age, caloric intake (quintiles), and pack-years of smoking and for geographic region and total fluid intake in the HPFS
			0	45	1.35 (0.94–1.96)	
			1–3 servings/mo	88	1	
			1 serving/wk	153	1.01 (0.78–1.33)	
			2–4 serving/wk	196	1.11 (0.85–1.45)	
			≥ 5 servings/wk	22	0.93 (0.57–1.52)	
		Urinary bladder	Frequency of red meat (beef, pork, lamb as main dish) intake among women			Age, caloric intake (quintiles), and pack-years of smoking and for geographic region
			0	6	2.28 (0.88–5.92)	
			1–3 servings/mo	15	1	
			1 serving/wk	60	1.35 (0.76–2.39)	
			2–4 serving/wk	173	1.23 (0.71–2.11)	
			≥ 5 servings/wk	50	1.01 (0.56–1.85)	
		Urinary bladder	Frequency of hamburger intake among men			Same as above

Table 2.9.1 Cohort studies: Red meat and other cancers (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
			0	54	0.99 (0.72–1.36)	
			1–3 servings/mo	148	1	
			1 serving/wk	171	0.86 (0.68–1.08)	
			2–4 serving/wk	131	0.91 (0.7–1.17)	
			≥ 5 servings/wk	9	0.83 (0.4–1.71)	
		Urinary bladder	Frequency of hamburger intake among women			Same as above
			0	7	1.07 (0.48–2.41)	
			1–3 servings/mo	44	1	
			1 serving/wk	142	1.13	
			2–4 serving/wk	111	0.96 (0.66–1.38)	
		Urinary bladder	Frequency of red meat (beef, pork, lamb as sandwich or mixed dish) intake among men			Same as above
			0	71	1.06 (0.79–1.43)	
			1–3 servings/mo	133	1	
			1 serving/wk	137	0.83 (0.65–1.06)	
			2–4 serving/wk	151	1.26 (0.98–1.63)	
			≥ 5 servings/wk	12	0.95 (0.51–1.75)	
		Urinary bladder	Frequency of red meat (beef, pork, lamb as sandwich or mixed dish) intake among women			Same as above
			0	16	1.61 (0.92–2.81)	
			1–3 servings/mo	66	1	
			1 serving/wk	105	1.03 (0.75–1.41)	
			2–4 serving/wk	108	0.92 (0.66–1.27)	
			≥ 5 servings/wk	9	0.83 (0.4–1.71)	

Table 2.9.1 Cohort studies: Red meat and other cancers (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. (2007) USA 1995; follow-up to 2003 Cohort	119 312/ 552 cases; Women, aged 50–71 y, from six states in the United States (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and two metropolitan areas (Atlanta, Georgia; and Detroit, Michigan). **Exposure assessment method:** Questionnaire; Total red meat(beef, pork, lamb, bacon, beef cold cuts, ham, hamburger, hot dogs, liver and sausages). Unprocessed red meat was not studied separately. A 124-item food frequency questionnaire (FFQ), based on the Diet History Questionnaire.	Ovary: ovarian cancer ICD-0–3	Quintiles of total red meat intake (median g/1000 kcal)			Age, sex, education, marital status, family history of cancer, race, BMI, smoking, frequency of vigorous physical activity, total energy intake, alcohol intake, fruit and vegetable intake.
			Q1 (9.8)	149	1	
			Q2 (21.4)	131	1.2 (0.92–1.56)	
			Q3 (31.4)	92	0.97 (0.73–1.28)	
			Q4 (42.9)	110	1.09 (0.82–1.45)	
			Q5 (62.7)	70	1.19 (0.89–1.59)	
			Trend-test p-value: 0.33			
Schulz et al. (2007) Europe: Denmark, France, Germany, Greece, Italy, the Netherlands, Norway, Spain, Sweden, United Kingdom 1992–2000; follow-up to 2004 Cohort	325 731/581 cases of primary invasive ovarian cancer; Study participants from 10 European countries, mostly from the general population, recruited between 1992 and 2000. Women free of any cancer at baseline, with at least one intact ovary, and with non-missing dietary and follow-up information were included in analyses. **Exposure assessment method:** Questionnaire; Dietary intake was assessed by several different instruments that had been developed and validated previously in a series of studies within the various source populations participating in EPIC: Extensive self-administrated quantitative dietary questionnaires, containing up to 260 food items and estimating individual average portions systematically, questionnaires but structured by meals, face-to-face dietary interview using a computerised dietary program, semiquantitative food-frequency questionnaires with standard portions, or combined dietary methods: both a semiquantitative FFQ and a 7-day record, or combining a short non-quantitative FFQ with a	Ovary: ovarian cancer ICD-10 C56	Quintiles of red meat intake (g/day)			Body mass index, parity, menopausal status, ever use of oral contraceptives, total energy intake, education, smoking, unilateral ovariectomy, and hormone replacement therapy use at baseline.
			Q1 (< 25)	95	1	
			Q2 (25– < 35)	116	1.22 (0.87–1.69)	
			Q3 (35– < 44)	122	1.13 (0.79–1.61)	
			Q4 (44– < 55)	134	1.13 (0.78–1.63)	
			Q5 (> 55)	114	1.04 (0.7–1.56)	
			Trend-test p-value: 0.89			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
	14-day record on hot meals (lunches and dinners). Red meat not defined.					
Kabat et al. (2008) Canada 1980–1985; mean follow-up 16.4 years Cohort	34 148 analytical cohort/426 cases; Women aged 40–59, with intact uterus, from the general Canadian population **Exposure assessment method:** Questionnaire; Red meat not defined.	Endometrium	Quintiles of red meat consumption (g/day)			Continuous: age, BMI, age at menarche, total calorie intake, raw vegetables intake, alcohol intake; menopausal status; parity; duration of OC use; duration of HR use; physical activity; education
			Q1: < 48.49	87	1	
			Q2: 48.49– < 66.33	91	1.14 (0.84–1.55)	
			Q3: 66.33– < 83.47	85	1.08 (0.79–1.47)	
			Q4: 83.47– < 108.99	95	1.26 (0.93–1.72)	
			Q5: > 108.99	64	0.86 (0.61–1.22)	
			Trend-test p-value: 0.75			
		Endometrium	Quintiles of heme iron intake (mg/day)			Same as above
			Q1: < 1.58	93	1	
			Q2: 1.58– < 1.99	96	1.1 (0.82–1.48)	
			Q3: 1.99– < 2.40	86	1 (0.74–1.37)	
			Q4: 2.40– < 2.95	82	0.98 (0.72–1.37)	
			Q5: > 2.95	69	0.82 (0.59–1.16)	
			Trend-test p-value: 0.22			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
Lee et al. (2008) USA, Canada, Australia, Netherland, Sweden, Finland. 7–20 years Cohort	530 469 women and 244 483 men; pooled analysis of 13 prospective studies. 530 469 women and 244 483 men/1478 cases (709 women and 769 men) **Exposure assessment method:** Questionnaire; 7–20 years of follow up, all cohorts have used validated FFQ. Red meat (beef, pork, lamb, liver and veal).	Kidney: renal cell cancer O-2	Red meat intake category			Age, history of hypertension, body mass index, pack-years of smoking, combination of parity and age at first birth age at first child's birth < 25 years and parity of 1 or 2; age at first child's birth ≥ 25 years and parity of 1 or 2, or nulliparous; age at first child's birth < 25 years and parity of ≥ 3; and age at first child's birth ≥ 25 years and parity of ≥□3), fruit and vegetable consumption (tertiles), alcohol intake (continuous), and total energy intake (continuous).
			< 20 g/d	216	1.01 (0.85–1.2)	
			20 to < 60 g/d	621	1	
			60 to < 80 g/d	241	1.07 (0.91–1.25)	
			≥ 80 g/day = 4 servings/week	400	0.99 (0.85–1.16)	
			Trend-test p-value: 0.93			
Larsson et al. (2009) Sweden 1997 Cohort	82 002/ 485 cases; participants of the Swedish Mammography Cohort (SMC) and the Cohort of Swedish Men (COSM). **Exposure assessment method:** Questionnaire; diet was assessed using a self-administered food frequency questionnaire (FFQ) with 96 food items. 9.4 years of follow-up, and the EPIC study in 10 European countries. Red meat (beef, pork, veal, hamburger, meat balls, liver and kidney).	Urinary bladder: (C67.0–C67.9)	Frequency of red meat intake			Adjusted for age, sex, education, smoking status, pack-years of smoking, and total energy intake
			0–3 servings/month	45	1	
			1–4 servings/week	276	1.11 (0.81–1.52)	
			> 5 servings/week	164	1 (0.71–1.41)	
			Trend-test p-value: 0.57			
		Urinary bladder: (C67.0–C67.9)	Frequency of hamburger or meat balls intake			Same as above
			0–3 servings/month	172	1	
			1–4 servings/week	274	0.96 (0.79–1.16)	
			≥ 5 servings/week	39	0.85 (0.59–1.21)	

Table 2.9.1 Cohort studies: Red meat and other cancers (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
			Trend-test p-value: 0.36			
		Urinary bladder: (C67.0–C67.9)	Frequency of beef, pork or veal intake			Same as above
			0–3 servings/month	89	1	
			1–4 servings/week	375	1.11 (0.87–1.4)	
			≥ 5 servings/week	21	0.79 (0.48–1.28)	
			Trend-test p-value: 0.50			
Tsai et al. (2010) US Various Cohort	525 982; This is a pooled analysis of NIH-AARP Diet and Health Study and the PLCO cancer screening trial. Criteria is different for the two studies **Exposure assessment method:** Questionnaire; Diet History Questionnaire was used	NHL: Chronic lymphocytic leukaemia and small lymphocytic lymphoma (SLL/CLL)	Red meat, (g/1,000 kcal)			Age, sex, BMI
			0.0–19.6	274	1	
			19.6–31.8	295	1.01 (0.85–1.19)	
			31.8–46.7	288	0.96 (0.81–1.14)	
			46.7–250.5	272	0.9 (0.76–1.08)	
			Trend-test p-value: 0.22			
Gilsing et al. (2011) Netherlands 1986; follow-up to 2002 Cohort	62 573/340 cases; the Netherlands Cohort Study (NCLS) was initiated in September 1986 and includes 62 573 women, aged 55–69 y at baseline, who originated from 204 municipalities with computerized population registries **Exposure assessment method:** Questionnaire; 16,3 years of follow-up. 150-item semiquantitative food-frequency questionnaire (FFQ) at baseline that estimated the average frequency and amounts of foods and beverages consumed over the previous 12 months. Unprocessed red meat (beef, pork, minced meat and liver).	Ovary	Quintiles of red meat intake – median (g/day)			Age, total energy intake, parity, and use of oral contraceptives
			Q1: 36.2	51	1	
			Q2: 61.3	77	1.58 (1.08–2.3)	
			Q3: 77.9	73	1.47 (1–2.16)	
			Q4: 95.6	92	1.78 (1.23–2.58)	
			Q5: 129.6	47	0.93 (0.61–1.42)	
			Trend-test p-value: 0.85			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
		Ovary	Quintiles of beef intake, median g/day			Same as above
			Q1: 2.2	68	1	
			Q2: 10.7	53	0.77 (0.52–1.13)	
			Q3: 18.9	58	0.98 (0.68–1.42)	
			Q4: 30.7	67	0.95 (0.66–1.38)	
			Q5: 50.4	84	1.15 (0.81–1.64)	
			Trend-test p-value: 0.23			
		Ovary	Quintiles of pork intake, median g/day			Same as above
			Q1: 3.5	62	1	
			Q2: 18.3	74	1.26 (0.87–1.81)	
			Q3: 31.1	71	1.21 (0.84–1.76)	
			Q4: 44.7	67	1.14 (0.78–1.66)	
			Q5: 71.2	66	1.08 (0.75–1.59)	
			Trend-test p-value: 0.88			
		Ovary	Quintiles of minced meat intake, median g/day			Same as above
			Q1: 0	66	1	
			Q2: 7.6	67	1.06 (0.73–1.53)	
			Q3: 13.4	83	1.26 (0.89–1.8)	
			Q4: 21.4	69	1.13 (0.78–1.63)	
			Q5: 36.6	55	0.86 (0.59–1.27)	
			Trend-test p-value: 0.64			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
		Ovary	Levels of liver intake, g/day (median)			Same as above
			0	227	1	
			> 0 (3.3)	113	1.07 (0.84–1.38)	
Jakszyn et al. (2011) 10 European countries: Denmark, France, Germany, United Kingdom, Greece, Italy, Norway, Spain, Sweden, the Netherlands Enrollment 1992–2000, mean follow-up 8.7 years Cohort	481 419/ 1001 cases of bladder cancer; Participants from the European Prospective Investigation into Cancer and Nutrition (EPIC) study, in most centres recruited from the general population. However, French participants were female members of a health insurance for school and university employees. Spanish and Italian participants were recruited among blood donors, members of health insurance programs, employees of enterprises, civil servants and the general population. In Utrecht and Florence, participants in mammographic screening programs were recruited. In Oxford, half of the cohort consisted of "health conscious" subjects from England, Wales, Scotland and Northern Ireland, including a high percentage of vegans, ovo-lacto vegetarians, fish eaters (consuming fish but no meat) and meat eaters. The cohorts of France, Norway, Utrecht and Naples include women only. **Exposure assessment method:** Questionnaire; Diet was assessed over the previous 12 months by structured questions regarding meals or food groups, individual average portions, or standard portion. The questionnaires were validated and calibrated with 24-hour dietary recall data Red meat is defined as beef, pork and mutton/lamb.	Urinary bladder	Quartiles of red meat intake (Fresh and processed, g/day)			Educational level, BMI, smoking status, lifetime intensity of smoking (number of cigarettes per day), time since quitting or duration of smoking, and total energy intake
			Q1 (0–57.86)	144	1	
			Q2 (57.86–91.42)	233	1.2 (0.96–1.49)	
			Q3 (91.42–130.63)	269	1.14 (0.91–1.42)	
			Q4 (130.63–754.79)	355	1.15 (0.9–1.45)	
			Trend-test p-value: 0.49			
		Urinary bladder	Quartiles of heme iron intake (mg/day)			Same as above
			Q1 (0 < 0.6)	171	1	
			Q2 (0.6– < 1.02)	219	1.04 (0.84–1.28)	
			Q3 (1.02– < 1.53)	268	1.09 (0.88–1.35)	
			Q4 (1.53–4)	343	1.1 (0.88–1.39)	
			Trend-test p-value: 0.39			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
Rohrmann et al. (2011) Europe 1992; 8,5 years of follow-up Cohort	410 411; Participants from the European Prospective Investigation into Cancer and Nutrition (EPIC) study, in most centres recruited from the general population. However, French participants were female members of a health insurance for school and university employees. Spanish and Italian participants were recruited among blood donors, members of health insurance programs, employees of enterprises, civil servants and the general population. In Utrecht and Florence, participants in mammographic screening programs were recruited. In Oxford, half of the cohort consisted of "health conscious" subjects from England, Wales, Scotland and Northern Ireland, includings a high percentage of vegans, ovo-lacto vegetarians, fish eaters (consuming fish but no meat) and meat eaters. The cohorts of France, Norway, Utrecht and Naples include women only. **Exposure assessment method:** Questionnaire; Diet was assessed over the previous 12 months by structured questions regarding meals or food groups, individual average portions, or standard portion. The questionnaires were validated and calibrated with 24-hour dietary recall data Red meat is defined as beef, pork and mutton/lamb.	NHL: Non-Hodgkin's lymphoma (ICD-O-3)	Quintiles of red meat consumption			Stratified by age in 1 yr categories, stratified by centre, stratified by sex, adjusted for energy, alcohol, education, fruits, vegetables and smoking
			Q1 (< 20 g/day)	285	1	
			Q2 (20– < 40 g/day)	306	0.92 (0.78–1.09)	
			Q3 (40– < 60 g/day)	260	1.03 (0.85–1.24)	
			Q4 (60– < 80 g/day)	188	1.04 (0.84–1.28)	
			Q5 (≥ 80 g/day)	228	1.01 (0.82–1.26)	
			Trend-test p-value: 0.55			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
van Lonkhuijzen et al. (2011) Canada 1992–1998 Cohort	26 024/ 107 cases; Alumni from two Ontario universities, with a small portion of the cohort consisting of volunteers recruited through the Canadian Cancer Society **Exposure assessment method:** Questionnaire; quantitative food–frequency questionnaire with 166 food items, average follow-up = 6.5 years for cases and 11.7 years for subcohort members. Red meat (beef, pork, veal and lamb).	Endometrium	Quartiles of red meat intake (g/day)			Age, BMI, age at menarche, number of live births, breastfeeding, years of OC use, avg exercise/wk, Kcal intake/d, intake of cruciferous vegetables, menopausal status at baseline, HRT
			Q1: < 22.09	18	1	
			Q2: 22.09– < 35.41	26	1.3 (0.69–2.46)	
			Q3: 35.4 – < 52.15	28	1.32 (0.7–2.5)	
			Q4: ≥ 52.15	35	1.62 (0.86–3.08)	
			Trend-test p-value: 0.13			
Daniel et al. (2012b) US 1995–1996 Cohort	492 186/ 1,814 cases; US men and women, aged 50–71 y, residing in 6 states (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and 2 metropolitan areas (Atlanta, GA, and Detroit, MI). **Exposure assessment method:** Questionnaire; The largest prospective study of renal cell carcinoma was based on the NIH-AARP Diet and Health Study, validated 124-items FFQ. Red meat: beef, pork, hamburger, steak, and liver.	Kidney: renal cell carcinoma C649	Quintiles of red meat consumption, (median values), g/1000kcal			Age, sex, total energy intake, other types of meat intake, education, marital status, family history of cancer, race, BMI, smoking status, history of diabetes, history of hypertension, intakes of alcohol, fruit, and vegetables
			Q1(6.8)	327	1	
			Q2 (15.3)	385	1.12 (0.96–1.31)	
			Q3 (22.7)	327	0.93 (0.78–1.09)	
			Q4 (31.6)	366	1.01 (0.86–1.2)	
			Q5 (48.1)	409	1.08 (0.92–1.28)	
			Trend-test p-value: 0.99			
		Kidney: renal cell carcinoma C649	Quintiles of heme iron intake (median values, 100μg/1000kcal)			Same as above
			Q1(48.1)	193	1	
			Q2 (100.9)	184	0.89 (0.72–1.09)	
			Q3 (151.3)	223	1.04 (0.86–1.27)	
			Q4 (212.7)	231	1.05 (0.86–1.28)	
			Q5 (336.0)	258	1.15 (0.94–1.4)	
			Trend-test p-value: 0.03			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
		Kidney: papillary cell carcinoma, ICD-O-3	Quntiles of red meat consumption (median values, g/1000kcal)			Same as above
			Q1 (6.8)	21	1	
			Q2 (15.3)	22	1 (0.53–1.87)	
			Q3 (22.7)	15	0.72 (0.35–1.46)	
			Q4 (31.6)	26	1.33 (0.7–2.55)	
			Q5 (48.1)	31	1.79 (0.94–3.42)	
			Trend-test p-value: 0.008			
		Kidney: papillary cell carcinoma, ICD-O-3	Quintiles of heme iron intake (median values, 100µg/1000kcal)			Same as above
			Q1 (48.1)	14	1	
			Q2 (100.9)	15	1.15 (0.55–2.4)	
			Q3 (151.3)	11	0.91 (0.4–1.99)	
			Q4 (212.7)	18	1.57 (0.76–3.26)	
			Q5 (336.0)	25	2.36 (1.16–4.83)	
			Trend-test p-value: 0.003			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
Daniel et al. (2012a) United States 1995–1996; 9 years of follow-up Cohort	492 186; Men and women from the NIH-AARP Diet and Health Study aged 50–71 years, from 6 states (CA, FL, LA, NJ, NC, PA) and 2 metropolitan areas (Atlanta, GA and Detroit, MI) **Exposure assessment method:** Questionnaire; 124-item FFQ developed and validated by the National Cancer Institute. Red meat defined as all fresh: beef, pork, hamburger, steak, and liver.	NHL: Non-Hodgkin's lymphoma (ICD-O-3)	Quintiles of red meat consumption			Age, sex, education, family history of any cancer, race, BMI, smoking status, physical activity, intake of alcohol, intake of fruit, intake of vegetables, total energy, other meat intake
			Q1 (median intake 6.8 g/1000 kcal)	716	1	
			Q2 (median intake 15.3 g/1000 kcal)	757	1.01 (0.91–1.12)	
			Q3 (median intake 22.7 g/1000 kcal)	747	0.99 (0.89–1.11)	
			Q4 (median intake 31.6 g/1000 kcal)	720	0.97 (0.86–1.09)	
			Q5 (median intake 48.1 g/1000 kcal)	671	0.93 (0.83–1.05)	
			Trend-test p-value: 0.27			
Genkinger et al. (2012) Sweden 1987–1990, follow-up 21 years Cohort	60 895 cohort/ 720 cases; Women without history of cancer or hysterectomy, living in Uppsala County in central Sweden, born between 1914 and 1948 and women living in the adjacent Västmanland County, born between 1917 and 1948. **Exposure assessment method:** Questionnaire; Validated 67-items FFQ at baseline 1987–1990 (60 895 women) and 96-item FFQ in 1997 (39 227 women). Red meat included hamburgers, meatballs, beef, pork, and veal. Total liver included liver, liver pate and kidney.	Endometrium	Baseline red meat intake categories (g/wk)			Age, energy, BMI, parity, education.
			< 100	27	1	
			100 to > 200	62	0.89 (0.57–1.4)	
			200 to < 300	136	1.07 (0.71–1.62)	
			300 to < 400	162	1.1 (0.73–1.65)	
			400 to < 500	146	1.26 (0.83–1.91)	
			500 to < 600	94	1.32 (0.85–2.04)	
			≥ 600	91	1.06 (0.68–1.66)	
			Trend-test p-value: 0.11			
		Endometrium	Baseline liver intake categories, g/week (median)			Same as above
			< 100 (17.00)	577	1	
			≥ 100 (121.57)	130	1.29 (1.06–1.56)	
			Trend-test p-value: 0.01			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
		Endometrium	Quartiles of heme iron intake (median, mg/day)			Age, energy, BMI, parity, education, smoking, menopausal status, physical activity, OC use.
			Q1: 0.49	168	1	
			Q2: 0.90	161	1.05 (0.85–1.3)	
			Q3: 1.37	193	1.12 (0.91–1.39)	
			Q4: 2.04	198	1.24 (1.01–1.53)	
			Trend-test p-value: 0.03			
Arem et al. (2013) USA 1995–1996; mean follow-up 9.3 years Cohort	111 356 analytic cohort/ 1,486 cases; Women aged 50–71 years satisfactorily completed mailed questionnaires in 1995–1996 **Exposure assessment method:** Questionnaire; Based on the NIH-AARP Diet and Health Study, validated 124-items FFQ. Red meat: beef, pork, hamburger, steak, and liver.	Endometrium	Quintiles of daily red meat intake (g/1000kcal, mean)			Age; BMI; smoking status; continuous total energy intake; mutually adjusted for other meat intake; age at menarche; age at first child's birth, parity; age at menopause; HT use; OC use; diabetes and physical activity.
			Q1: 7.1	271	1	
			Q2: 17.2	265	0.9 (0.76–1.07)	
			Q3: 25.9	295	0.97 (0.82–1.14)	
			Q4: 36.2	271	0.85 (0.72–1.01)	
			Q5: 58.5	302	0.91 (0.77–1.08)	
			Trend-test p-value: 0.45			
Fedirko et al. (2013) Europe Enrollment 1992–2000; mean follow-up time 11.4 years Cohort	477 206 (142 194 men and 335 012 women); Participants of the European Prospective Investigation into Cancer and Nutrition (EPIC) study. Mostly from the general population. However, French participants were female members of a health insurance for school and university employees. Spanish and Italian participants were blood donors, members of health insurance programs, employees of enterprises, civil servants and the general population. In Utrecht and Florence, participants in mammographic screening programs were recruited. In Oxford, half of the cohort consisted of "health conscious" subjects from England, Wales, Scotland and Northern Ireland, including	Liver: hepatocellular carcinoma (ICD10)	Quartiles of red meat consumption (g/day)			Non-alcohol energy, baseline alcohol intake, intake of other types of meat (processed meat, poultry and total fish), smoking status, sex-specific physical activity, self-reported diabetes status, life-time alcohol intake pattern, continuous measures of body mass index, baseline intake of coffee, baseline intake of dietary fibre
			Q1 (0–16.6 g/day)	21	1	
			Q2 (16.6–36.1 g/day)	50	1.7 (0.98–2.94)	
			Q3 (36.1–63.4 g/day)	58	1.62 (0.93–2.84)	
			Q4 (> 63.4 g/day)	62	1.25 (0.68–2.27)	
			Trend-test p-value: 0.95			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
	a high percentage of vegans, ovo-lacto vegetarians, fish eaters, and meat eaters. The cohorts of France, Norway, Utrecht and Naples include women only. **Exposure assessment method:** Questionnaire; Red meat: all fresh, minced, and frozen beef, veal, pork, mutton, lamb, horse and goat.	Liver: hepatocellular carcinoma (ICD10)	Red meat intake as continuous variable (per 10 g/day)			Same as above
			Red meat consumption per 10 g/day	191	1.01 (0.96–1.05)	
Saberi-Hosnijeh et al. (2014) Europe, multicentre (Denmark, France, Greece, Germany, Italy, Netherlands, Norway, Spain, Sweden, United Kingdom) Enrollment: 1992–2000. Follow-up: end of 2010 Cohort	477 325; 142 259 men, 335 066 women, mostly age 35–70 y at recruitment, without cancer history **Exposure assessment method:** Questionnaire; Standardized lifestyle and personal history questionnaires and anthropometric data were collected from most participants. Diet over the previous 12 months measured at recruitment by validated country-specific questionnaires designed to ensure high compliance and better measures of local dietary habits. Red meat not defined.	Leukaemia: All leukaemia	Quintiles of red meat intake (g/day)			BMI, education, smoking, alcohol consumption, physical activity, total energy intake
			Q1: 0–12.10	118	1	
			Q2: 12.1–26.8	151	1.09 (0.85–1.41)	
			Q3: 26.84–44.56	163	1.11 (0.85–1.44)	
			Q4: 44.57–70.37	155	1.02 (0.77–1.34)	
			Q5: 70.38–722.2	186	1.09 (0.81–1.46)	
			Calibrated HR per 50 g/day	773	0.98 (0.85–1.09)	
			Trend-test p-value: 0.83			
		Leukaemia (Myeloid): Myeloid leukaemia	Quintiles of red meat intake (g/day)			Same as above
			Q1: 0–12.10	54	1	
			Q2: 12.1–26.8	68	1.14 (0.78–1.68)	
			Q3: 26.84–44.56	84	1.34 (0.91–1.96)	
			Q4: 44.57–70.37	53	0.84 (0.54–1.29)	
			Q5: 70.38–722.2	83	1.27 (0.82–1.97)	
			Calibrated HR per 50 g/day	342	1.06 (0.76–1.49)	
			Trend-test p-value: 0.74			
		Leukaemia	Quintiles of red meat intake (g/day)			Same as above

Table 2.9.1 Cohort studies: Red meat and other cancers (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
		(Lymphoid): Lymphoid leukaemia	Q1: 0–12.10	56	1	
			Q2: 12.1–26.8	67	0.98 (0.66–1.47)	
			Q3: 26.84–44.56	72	0.98 (0.65–1.48)	
			Q4: 44.57–70.37	90	1.1 (0.73–1.69)	
			Q5: 70.38–722.2	88	0.96 (0.61–1.51)	
			Calibrated HR per 50 g/day	373	0.89 (0.65–1.22)	
			Trend-test p-value: 0.95			
		Leukaemia: Acute myeloid leukaemia (AML)	Quartiles of red meat intake (g/day)			Same as above
			Q1: 0–16.0	42	1	
			Q2: 16.1–34.7	45	0.99 (0.63–1.55)	
			Q3: 34.8–63.04	46	1.05 (0.65–1.7)	
			Q4: 63.05–722.2	54	1.1 (0.66–1.84)	
			Calibrated HR per 50 g/day	187	1.01 (0.63–1.62)	
			Trend-test p-value: 0.68			
		Leukaemia: Chronic myeloid leukaemia (CML)	Quartiles of red meat intake (g/day)			Same as above
			Q1: 0–16.0	21	1	
			Q2: 16.1–34.7	27	1.13 (0.61–2.11)	
			Q3: 34.8–63.04	16	0.68 (0.32–1.44)	
			Q4: 63.05–722.2	16	0.76 (0.33–1.73)	
			Calibrated HR per 50 g/day	80	1.22 (0.59–2.52)	
			Trend-test p-value: 0.31			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
		Leukaemia: Chronic lymphoid leukaemia (CLL)	Quartiles of red meat intake (g/day)			Same as above
			Q1: 0–16.0	61	1	
			Q2: 16.1–34.7	85	1.2 (0.84–1.7)	
			Q3: 34.8–63.04	82	0.99 (0.68–1.46)	
			Q4: 63.05–722.2	105	1.01 (0.67–1.53)	
			Calibrated HR per 50 g/day	333	0.93 (0.67–1.29)	
			Trend-test p-value: 0.77			
Rohrmann et al. (2015) Europe 1992–2008 Cohort	477 231/691 cases; In most centres, the participants were recruited from the general population. However, French participants were female members of a health insurance for school and university employees. Spanish and Italian participants were recruited among blood donors, members of several health insurance programs, employees of several enterprises, civil servants, but also the general population. In Utrecht and Florence, participants in mammographic screening programs were recruited for the study. In Oxford, half of the cohort consisted of "health conscious" subjects from England, Wales, Scotland and Northern Ireland, which includes a high percentage of vegans, ovo-lacto vegetarians, fish eaters (consuming fish but no meat), and meat eaters. The cohorts of France, Norway, Utrecht and Naples include women only. **Exposure assessment method:** Questionnaire; Men and women were recruited between 1992 and 2000 and follow-up to December 2008, meat consumption was assessed at baseline using validated country-specific FFQs.	Kidney: renal cell cancer O-2	Red meat consumption categories (g/day)			Adjusted for age, centre, sex (if appropriate), education, BMI, history of hypertension, smoking status, duration of smoking, energy intake from fat sources, energy intake from non-fat sources, alcohol consumption, fruit consumption, vegetable consumption.
			0–9.9 g/day	44	1	
			10–19.9	82	1.35 (0.92–1.97)	
			20–39.9	189	1.38 (0.98–1.95)	
			40–79.9	238	1.38 (0.97–1.96)	
			80+	138	1.46 (0.99–2.15)	
			Trend-test p-value: 0.13			
		Kidney: renal cell cancer O-2	Red meat consumption among men (g/day)			Same as above
			0–9.9 g/day	22	1	
			10–19.9	43	1.48 (0.86–2.53)	
			20–39.9	95	1.2 (0.73–1.96)	
			40–79.9	129	1.1 (0.67–1.8)	
			80+	99	1.12 (0.66–1.91)	
			Trend-test p-value: 0.61			

Table 2.9.1 Cohort studies: Red meat and other cancers (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
	Red meat: beef, pork, mutton/lamb, horse, goat.	Kidney: renal cell cancer O-2	Red meat consumption among women (g/day)			Same as above
			0–9.9 g/day	22	1	
			10–19.9	39	1.25 (0.73–2.14)	
			20–39.9	94	1.6 (0.99–2.6)	
			40–79.9	109	1.8 (1.1–2.96)	
			80+	39	2.03 (1.14–3.63)	
			Trend-test p-value: 0.01			

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