

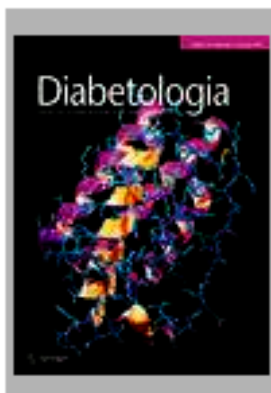
ASSOCIAZIONE TRA CONSUMO DI CARNE E INCIDENZA DI DIABETE TIPO 2: LO STUDIO EPIC-INTERACT.

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per conto del Consorzio InterAct

DIABETOLOGIA

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ARTICLE

Association between dietary meat consumption and
incident type 2 diabetes: the EPIC-InterAct study

The InterAct Consortium

Introduzione: Studi sia americani che europei hanno recentemente dimostrato che una dieta ricca di carne ed in particolare un elevato consumo di carne rossa fresca o conservata contribuisce in modo indipendente ad aumentare il rischio di diabete tipo 2 (DT2).

FIGURE 2

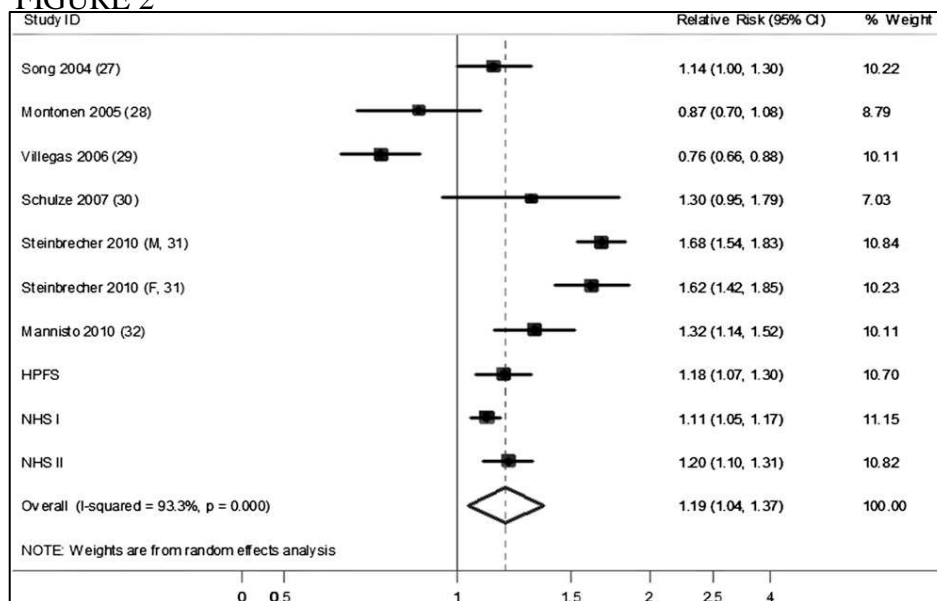


FIGURE 3

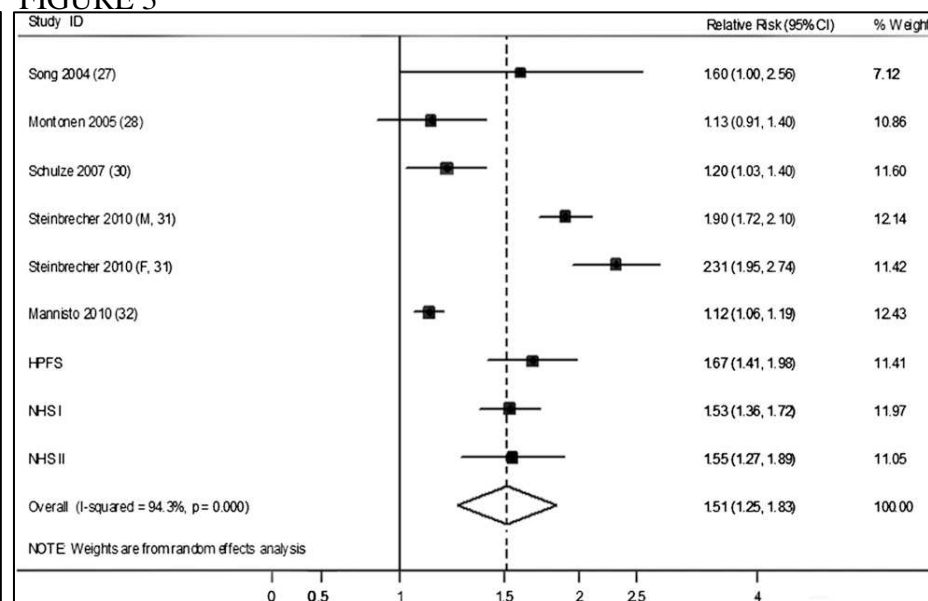
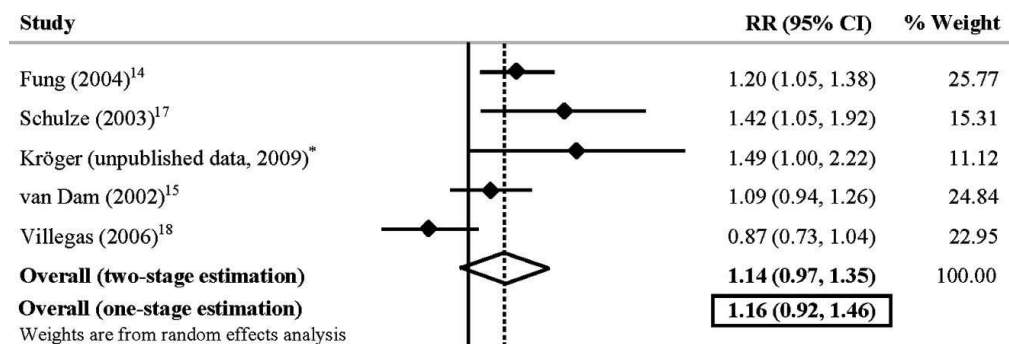
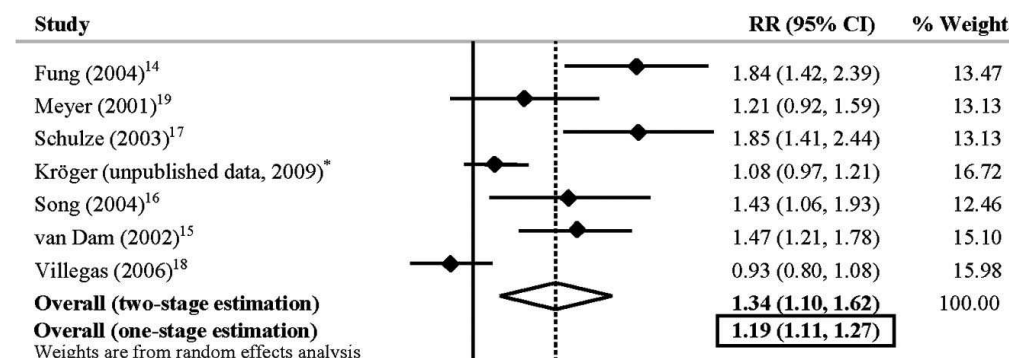


FIGURE 2. HRs for 100 g unprocessed red meat consumption per day and type 2 diabetes. The RR of each study is represented by a square, and the size of the square represents the weight of each study to the overall estimate. The 95% CIs are represented by the horizontal lines, and the diamond represents the overall estimate and its 95% CI. HPFS, Health Professionals Follow-Up Study; NHS, Nurses' Health Study.

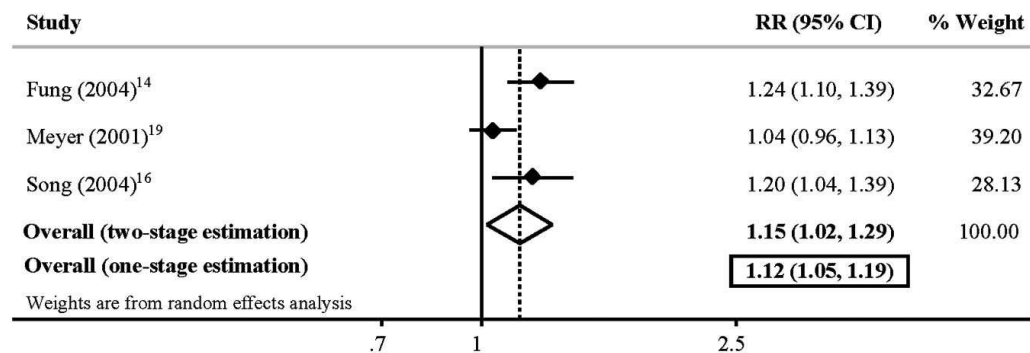
FIGURE 3. HRs for 50 g processed red meat consumption per day and type 2 diabetes. The RR of each study is represented by a square, and the size of the square represents the weight of each study to the overall estimate. The 95% CIs are represented by the horizontal lines, and the diamond represents the overall estimate and its 95% CI. HPFS, Health Professionals Follow-Up Study; NHS, Nurses' Health Study.



Relative risk of diabetes per 100 g/day of red meats



Relative risk of diabetes per 50 g/day of processed meats



Relative risk of diabetes per 100 g/day of total meats

Figure 3. Risk of incident diabetes mellitus associated with servings per day of red meat (top; 5 cohort studies, 298 982 participants, and 7349 events), processed meat (middle; 7 cohort studies, 372 279 participants, and 10 782 events), and total meat (bottom; 3 cohort studies, 142 851 participants, and 5923 events). *European Prospective Investigation Into Cancer and Nutrition–Potsdam Study, includes most recent results. Solid diamonds and lines are study-specific dose-response and 95% CI, respectively. Dashed line and open diamond are pooled dose-response and 95% CI, respectively, combining each study-specific dose-response (two-stage). The overall dose-response and 95% CI from generalized least squares for trend estimation (one-stage) is also shown.

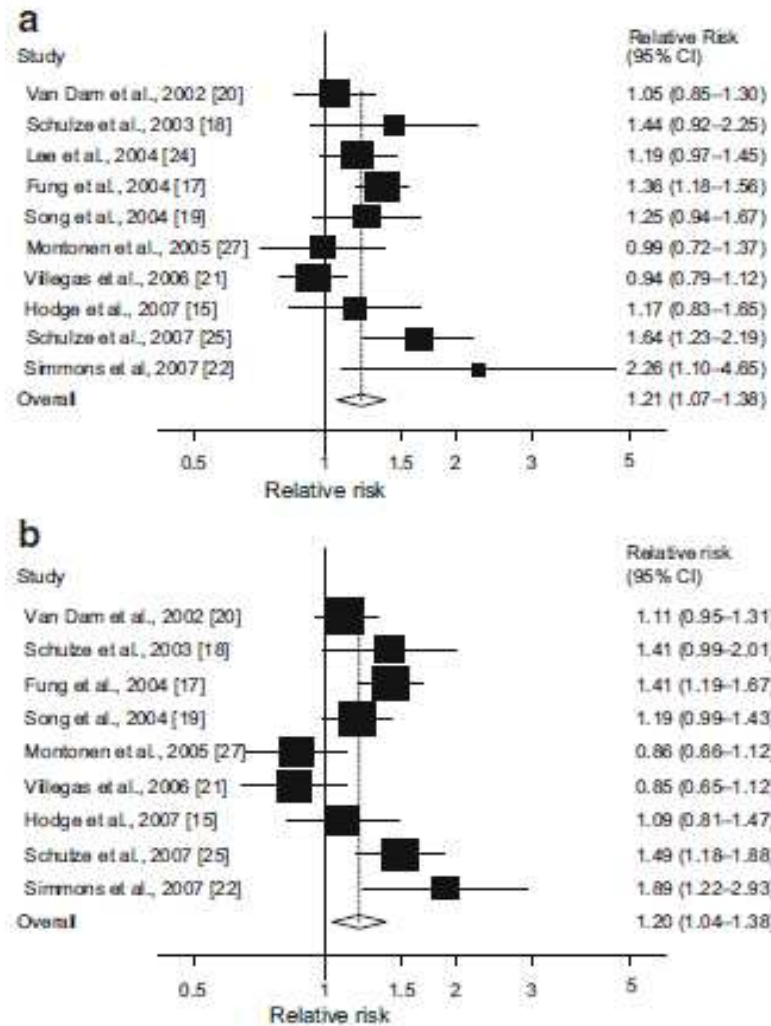


Fig. 3 Red meat and type 2 diabetes. RRs for (a) the highest vs the lowest intake and (b) per 20 g/day of red meat. The RR of each study is represented by a square and the size of the square represents the weight of each study to the overall estimate. 95% CIs are represented by the horizontal lines and the diamond represents the overall estimate and its 95% CI

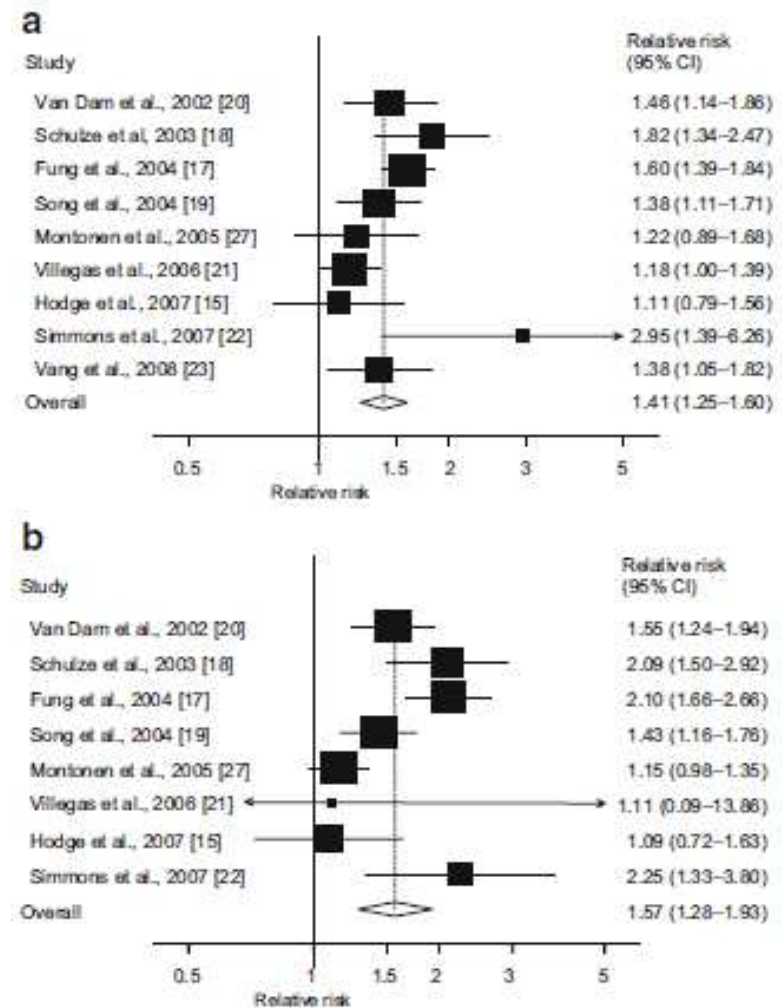


Fig. 4 Processed meat and type 2 diabetes. RRs for (a) the highest vs the lowest intake and (b) per 50 g/day of processed meat. The RR of each study is represented by a square and the size of the square represents the weight of each study to the overall estimate. 95% CIs are represented by the horizontal lines and the diamond represents the overall estimate and its 95% CI

Obiettivi: Con il presente studio è stata indagata l'associazione tra consumo di carne totale e dei diversi di carne e incidenza di DT2 nell'ambito del progetto **EPIC-InterAct**, un grande studio prospettico caso-coorte *nested* all'interno dello studio europeo EPIC (European Prospective Investigation into Cancer and Nutrition) tenendo così conto delle differenze nei modelli di consumo di carne in tutta Europa.

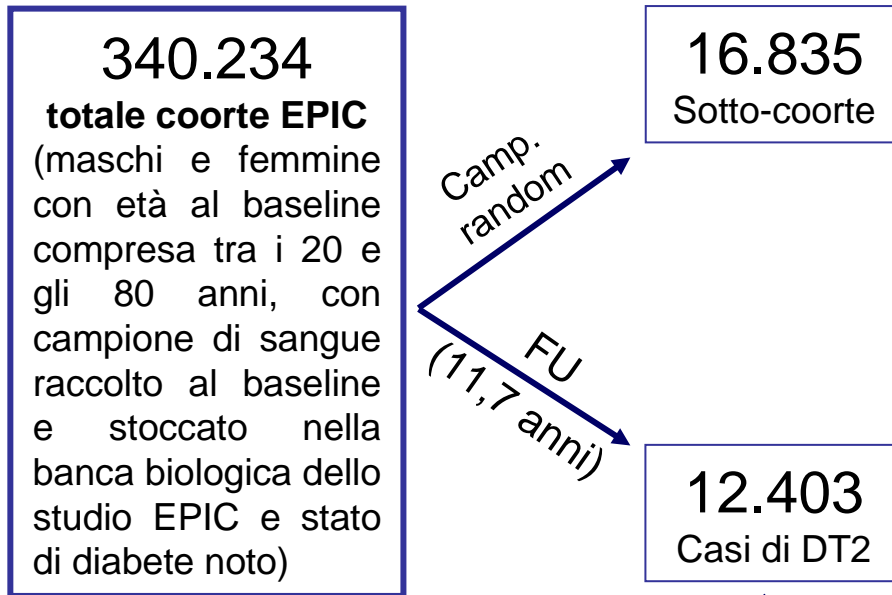


Il progetto EPIC-InterAct, approvato e finanziato dalla Comunità Europea (Sixth Framework Programme), ha lo scopo di investigare l'influenza dello stile di vita e dei fattori genetici (e le reciproche interazioni) sul rischio di sviluppare il diabete tipo 2 (DT2) in soggetti adulti provenienti da 26 coorti in 8 paesi europei.



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Metodi 1:



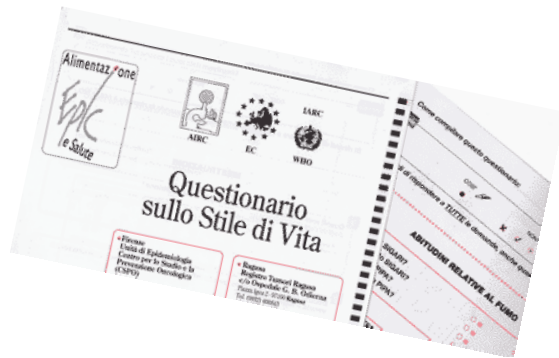
Esclusione dei soggetti:

- prevalenti per DT2 al baseline (548);
- con informazioni mancanti riguardo a dieta (117), fumo (241), BMI (169), attività fisica (289) e livello educativo (479);
- nel primo e nell'ultimo percentile del rapporto 'energy intake/energy requirement' (619).

Definizione dei casi da almeno due fonti indipendenti
(SDO, cartelle ambulatoriali, registri di patologia, prescrizioni farmaceutiche, codici di esenzione per patologia, cause di morte, self-reported).



Metodi 2: Per ogni partecipante sono state raccolte, all'arruolamento nello studio EPIC:



Informazioni sullo stile di vita tra cui abitudini al fumo, consumo di alcool, attività fisica svolta al lavoro e nel tempo libero, tipo di lavoro, livello educativo, storia riproduttiva e malattie pregresse;

Misure antropometriche (altezza, peso circonferenza vita e fianchi);

Consumo giornaliero di alimenti attraverso Food Frequency Questionnaires validati e specifici per ogni paese partecipante allo studio;

L'intake giornaliero dei principali nutrienti calcolato sulla base di specifiche tabelle di composizione degli alimenti;

Intake calorico giornaliero.
Indice e carico glicemico.



Metodi 3:



Consumo totale di carne.

Carne rossa: carne fresca di manzo, maiale, vitello, montone, agnello, capretto e cavallo. Hamburger, polpette e carne macinata.

Carne bianca: pollo, gallina, tacchino, anatra e oca, coniglio.

Carne conservata: prosciutto, pancetta, alimenti a base di fegato e altre carni conservate (sanguinaccio, salsicce, carne di manzo in scatola).

Frattaglie: fegato, rene, trippa, lingua, cuore e animelle.

Combinazione di carne rossa e carne conservata.

Intake medio giornaliero di ferro (eme e non eme) da carne.

Risultati:

- Il consumo medio giornaliero di carne totale per paese variava da 85,2 g / die (DS 54,1) nel Regno Unito a 134,3 g / die (DS 60,2) in Danimarca.
- Rispetto ai soggetti nel quintile più basso del consumo di carne totale, i soggetti nel quintile più alto erano meno istruiti, avevano circonferenza vita e indice di massa corporea maggiori ed erano più frequentemente fumatori.
- Gli hazard ratio (HR) e gli intervalli di confidenza (IC) per l'incidenza di DT2 in base al consumo di carne sono stati calcolati con modello Cox pesato con il metodo Prentice per il disegno di studio caso-coorte.

Table 3 HR and 95% CI of type 2 diabetes by quintiles (Q) of consumption and by increments of several types of meat and meat iron in the 26,088 individuals of the EPIC-InterAct case-cohort study

(14,529 subcohort non-cases, 729 subcohort type 2 diabetes cases and 10,830 non-subcohort type 2 diabetes cases)



Daily consumption	No. of cases	Basic model ^a		Multivariate model 1 ^b		Multivariate model 2 ^c	
		HR	CI	HR	CI	HR	CI
Total meat							
Q1 (m=61.6, w=38.3)	1,970	1.00		1.00		1.00	
Q2 (m=99.3, w=66.9)	2,070	1.16	1.06, 1.26	1.15	1.05, 1.25	1.01	0.91, 1.11
Q3 (m=129.7, w=90.0)	2,441	1.44	1.32, 1.57	1.39	1.27, 1.52	1.17	1.06, 1.30
Q4 (m=164.4, w=114.1)	2,347	1.50	1.37, 1.64	1.45	1.32, 1.59	1.19	1.07, 1.32
Q5 (m=228.1, w=155.4)	2,731	1.97	1.78, 2.16	1.82	1.65, 2.01	1.27	1.13, 1.42
<i>p</i> value for linear trend		<0.0001		<0.0001		<0.0001	
50 g increments		1.21	1.18, 1.24	1.18	1.15, 1.22	1.08	1.05, 1.12
Red meat							
Q1 (m=11.2, w=7.1)	2,061	1.00		1.00		1.00	
Q2 (m=30.8, w=20.4)	2,233	1.16	1.07, 1.27	1.16	1.06, 1.26	0.99	0.89, 1.11
Q3 (m=51.0, w=34.8)	2,285	1.26	1.16, 1.38	1.24	1.13, 1.36	1.10	1.00, 1.22
Q4 (m=76.3, w=52.1)	2,437	1.40	1.27, 1.53	1.33	1.21, 1.46	1.16	1.05, 1.29
Q5 (m=116.8, w=80.7)	2,543	1.57	1.42, 1.73	1.50	1.36, 1.56	1.20	1.07, 1.35
<i>p</i> value for linear trend		<0.0001		<0.0001		<0.0001	
50 g increments		1.20	1.15, 1.25	1.18	1.13, 1.23	1.08	1.03, 1.13
Processed meat							
Q1 (m=9.1, w=4.3)	2,015	1.00		1.00		1.00	
Q2 (m=23.2, w=13.2)	2,190	1.13	1.04, 1.22	1.13	1.04, 1.23	1.08	0.98, 1.19
Q3 (m=36.9, w=21.6)	2,275	1.20	1.10, 1.30	1.18	1.08, 1.28	1.03	0.94, 1.14
Q4 (m=55.7, w=34.4)	2,447	1.36	1.25, 1.48	1.31	1.20, 1.43	1.14	1.04, 1.26
Q5 (m=93.5, w=60.5)	2,632	1.61	1.47, 1.76	1.51	1.37, 1.65	1.16	1.04, 1.31
<i>p</i> value for linear trend		<0.0001		<0.0001		0.006	
50 g increments		1.30	1.23, 1.36	1.24	1.18, 1.31	1.12	1.05, 1.19

^aModel stratified by centre (the hazard function was stratified by centre) and adjusted for energy intake (log kJ) and sex; total, *n*=26,088; cases, *n*=11,559

^bMultivariate model 1: stratified by centre and adjusted for sex, energy intake (log kJ), smoking status (dummy variables for former and current smokers), alcohol consumption (quintiles of daily intake), physical activity (four levels) and educational level (five levels); total, *n*=26,088; cases, *n*=11,559

^cMultivariate model 2: multivariate model 1 with addition of a term for BMI (continuous); total, *n*=26,088; cases, *n*=11,559

Daily consumption	No. of cases	Basic model ^a		Multivariate model 1 ^b		Multivariate model 2 ^c	
		HR	CI	HR	CI	HR	CI
Red and processed meat							
Q1 (m=38.4, w=22.3)	1,991	1.00		1.00		1.00	
Q2 (m=71.0, w=45.4)	2,112	1.15	1.05, 1.25	1.11	1.01, 1.21	0.97	0.88, 1.08
Q3 (m=97.4, w=63.6)	2,328	1.34	1.23, 1.46	1.28	1.17, 1.40	1.08	0.97, 1.20
Q4 (m=129.0, w=85.3)	2,410	1.47	1.34, 1.61	1.39	1.26, 1.52	1.18	1.06, 1.31
Q5 (m=182.3, w=120.4)	2,718	1.84	1.67, 2.02	1.70	1.54, 1.88	1.18	1.04, 1.33
<i>p</i> value for linear trend		<0.0001		<0.0001		<0.0001	
50 g increments		1.23	1.1, 1.27	1.20	1.16, 1.24	1.09	1.05, 1.13
Offals							
Q1 (m=0.0, w=0.0)	5,862	1.00		1.00		1.00	
Q2 (m=0.9, w=0.6)	1,597	0.97	0.89, 1.06	0.99	0.90, 1.08	0.97	0.85, 1.07
Q3 (m=5.3, w=3.9)	4,100	1.11	1.04, 1.19	1.12	1.04, 1.19	1.04	0.96, 1.13
<i>p</i> value for linear trend		0.001		0.001		0.308	
10 g increments		1.09	1.0, 1.14	1.08	1.03, 1.14	1.00	0.94, 1.07
Poultry							
Q1 (m=0.6, w=0.3)	2,399	1.00		1.00		1.00	
Q2 (m=9.9, w=7.4)	2,208	0.95	0.87, 1.03	0.97	0.89, 1.06	0.98	0.89, 1.09
Q3 (m=16.9, w=15.2)	2,206	0.97	0.89, 1.06	1.00	0.91, 1.09	0.93	0.83, 1.03
Q4 (m=29.7, w=24.6)	2,356	1.05	0.97, 1.15	1.07	0.97, 1.16	0.99	0.89, 1.09
Q5 (m=53.8, w=49.3)	2,390	1.13	1.03, 1.24	1.12	1.02, 1.24	1.02	0.91, 1.13
<i>p</i> value for linear trend		0.001		0.003		0.786	
50 g increments		1.15	1.08, 1.23	1.12	1.05, 1.20	1.03	0.95, 1.11
Meat iron							
Q1 (m=1.2, w=0.7)	1,979	1.00		1.00		1.00	
Q2 (m=2.1, w=1.3)	2,197	1.21	1.11, 1.32	1.18	1.08, 1.29	1.10	1.00, 1.22
Q3 (m=2.8, w=1.9)	2,232	1.26	1.16, 1.38	1.21	1.11, 1.33	1.08	0.98, 1.20
Q4 (m=3.8, w=2.5)	2,446	1.44	1.32, 1.58	1.37	1.25, 1.50	1.16	1.05, 1.29
Q5 (m=5.4, w=3.7)	2,705	1.67	1.52, 1.83	1.58	1.44, 1.74	1.16	1.04, 1.30
<i>p</i> value for linear trend		<0.0001		<0.0001		0.009	
1 mg increments		1.06	1.03, 1.08	1.05	1.03, 1.08	1.02	0.998, 1.04

- Per il consumo di carne totale, rossa, conservata, bianca e per ferro, sono state osservate interazioni significative con il sesso (tutti i $p \leq 0,01$).



Table 4 Sex-specific HR and 95% CI of type 2 diabetes by quintiles (Q) of consumption and by increments of several types of meat in the 11,174 men and 14,914 women participating in the EPIC-InterAct study (results from the adjusted model)

Daily consumption	Men			Women		
	No. of cases	HR	CI	No. of cases	HR	CI
Total meat						
Q1 (m=61.6, w=38.3)	1,022	1.00		948	1.00	
Q2 (m=99.3, w=66.9)	977	0.92	0.78, 1.08	1,093	1.08	0.95, 1.23
Q3 (m=129.7, w=90.0)	1,283	1.24	1.06, 1.45	1,158	1.11	0.97, 1.27
Q4 (m=164.4, w=114.1)	1,177	1.27	1.08, 1.50	1,170	1.16	1.01, 1.33
Q5 (m=228.1, w=155.4)	1,302	1.38	1.15, 1.65	1,429	1.25	1.08, 1.45
<i>p</i> value for linear trend		<0.0001			0.003	
50 g increments		1.08	1.04, 1.13		1.09	1.04, 1.15
Red meat						
Q1 (m=11.2, w=7.1)	1,040	1.00		1,021	1.00	
Q2 (m=30.8, w=20.4)	1,151	1.07	0.92, 1.24	1,082	0.93	0.81, 1.08
Q3 (m=51.0, w=34.8)	1,145	1.14	0.98, 1.34	1,140	1.06	0.93, 1.22
Q4 (m=76.3, w=52.1)	1,203	1.27	1.08, 1.49	1,234	1.07	0.93, 1.23
Q5 (m=116.8, w=80.7)	1,222	1.30	1.09, 1.56	1,321	1.12	0.96, 1.30
<i>p</i> value for linear trend		0.001			0.042	
50 g increments		1.09	1.03, 1.17		1.06	0.98, 1.15
Processed meat						
Q1 (m=9.1, w=4.3)	993	1.00		1,022	1.00	
Q2 (m=23.2, w=13.2)	1,110	1.08	0.94, 1.24	1,080	1.07	0.94, 1.21
Q3 (m=36.9, w=21.6)	1,100	1.03	0.88, 1.20	1,175	1.03	0.91, 1.17
Q4 (m=55.7, w=34.4)	1,231	1.21	1.04, 1.40	1,216	1.10	0.97, 1.26
Q5 (m=93.5, w=60.5)	1,327	1.34	1.14, 1.57	1,305	1.07	0.92, 1.25
<i>p</i> value for linear trend		<0.0001			0.338	
50 g increments		1.15	1.07, 1.23		1.08	0.97, 1.20

HR and 95% CI from multivariate model 2: stratified by centre and adjusted for energy intake (log kJ), BMI (continuous), smoking status (dummy variables for former and current smokers), alcohol consumption (quintiles of daily intake), physical activity (four levels) and educational level (five levels)

Daily consumption	Men			Women		
	No. of cases	HR	CI	No. of cases	HR	CI
Red and processed meat						
Q1 (m=38.4, w=22.3)	975	1.00		1,016	1.00	
Q2 (m=71.0, w=45.4)	1,067	1.01	0.87, 1.18	1,045	0.94	0.82, 1.07
Q3 (m=97.4, w=63.6)	1,173	1.16	0.99, 1.36	1,155	1.00	0.87, 1.15
Q4 (m=129.0, w=85.3)	1,227	1.31	1.12, 1.54	1,183	1.10	0.95, 1.26
Q5 (m=182.3, w=120.4)	1,319	1.42	1.19, 1.69	1,399	1.05	0.90, 1.23
<i>p</i> value for linear trend		<0.0001			0.122	
50 g increments		1.12	1.07, 1.17		1.07	1.00, 1.14
Poultry						
Q1 (m=0.6, w=0.3)	1,273	1.00		1,126	1.00	
Q2 (m=9.9, w=7.4)	1,148	0.95	0.81, 1.11	1,060	1.01	0.88, 1.15
Q3 (m=16.9, w=15.2)	1,081	0.87	0.74, 1.01	1,125	1.00	0.87, 1.16
Q4 (m=29.7, w=24.6)	1,139	0.90	0.78, 1.04	1,217	1.10	0.95, 1.27
Q5 (m=53.8, w=49.3)	1,120	0.89	0.76, 1.04	1,270	1.19	1.02, 1.38
<i>p</i> value for linear trend		0.115			0.015	
50 g increments		0.94	0.85, 1.03		1.20	1.07, 1.34
Meat iron						
Q1 (m=1.2, w=0.7)	997	1.00		982	1.00	
Q2 (m=2.1, w=1.3)	1,112	1.14	0.98, 1.33	1,085	1.08	0.95, 1.22
Q3 (m=2.8, w=1.9)	1,156	1.18	1.01, 1.38	1,076	1.00	0.87, 1.14
Q4 (m=3.8, w=2.5)	1,247	1.29	1.11, 1.51	1,199	1.09	0.95, 1.26
Q5 (m=5.4, w=3.7)	1,249	1.25	1.06, 1.49	1,456	1.14	0.98, 1.32
<i>p</i> value for linear trend		0.005			0.095	
1 mg increments		1.02	1.00, 1.05		1.01	0.98, 1.05

- Una interazione significativa con il BMI è stata osservata anche per consumo di carne totale, carne rossa, carne conservata e carne bianca (tutti i $p < 0,0001$). I risultati delle analisi eseguite separatamente per classi BMI mostrano una progressiva attenuazione delle associazioni positive tra il consumo di carne e DT2 passando da soggetti normopeso a soggetti obesi.
- Aggiungendo al modello multivariato ulteriori aggiustamenti per il consumo di altri alimenti (verdure totali, pane, pasta, pesce e dolci) i risultati non cambiano.
- Escludendo un totale di 9865 individui che hanno riferito infarto del miocardio, angina, ictus, ipertensione o iperlipidemia al baseline, o escludendo gli individui con una diagnosi di DT2 nei primi 2 anni dopo l'arruolamento i risultati non cambiano.

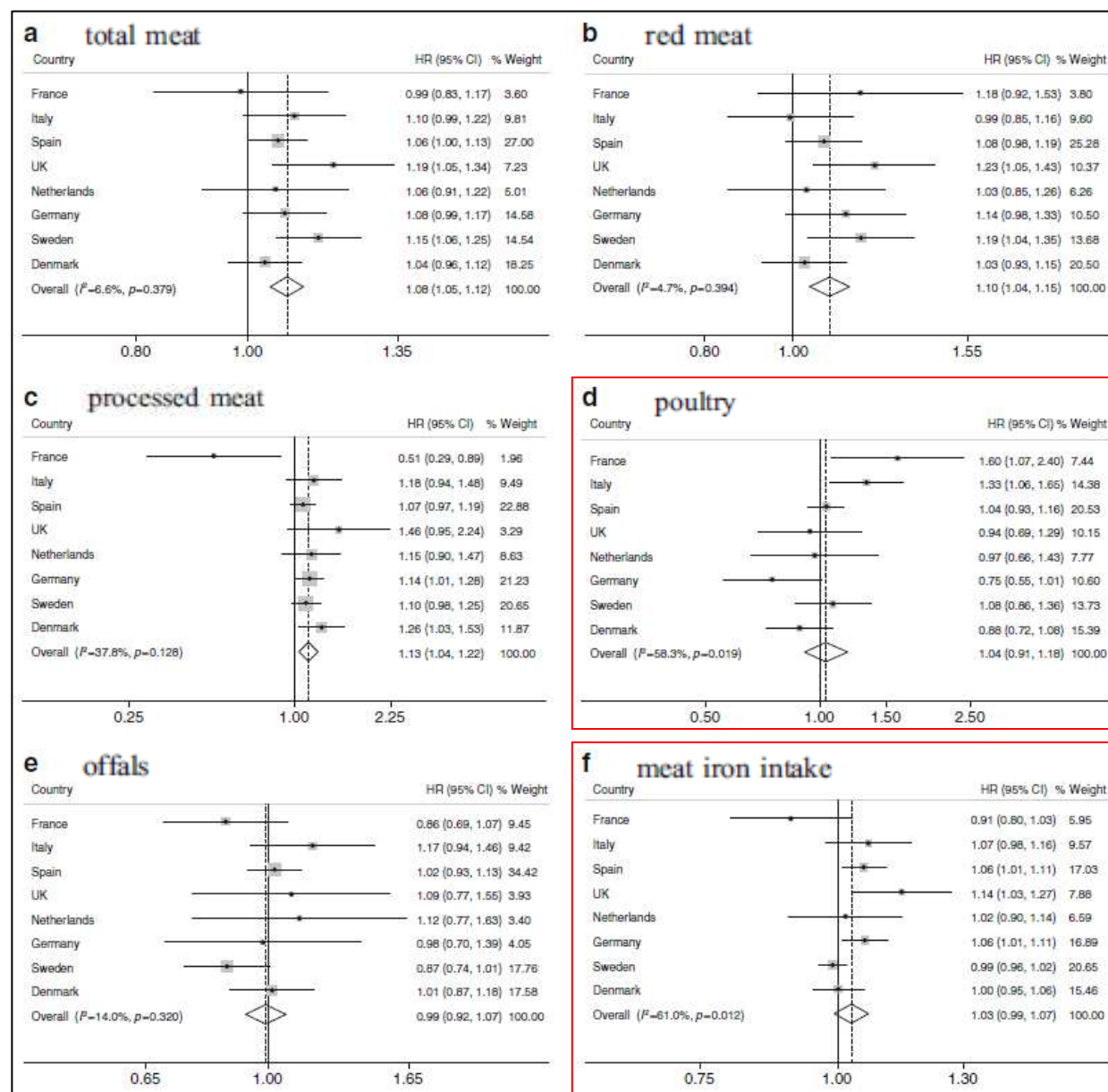


Fig. 1 Country-specific and overall HR for type 2 diabetes associated with 50 g increments of consumption of total meat (a), red meat (b), processed meat (c), poultry (d), offals (e) and meat iron intake (1 mg increments) (f) overall. HR and 95% CI derived by modified Cox proportional models stratified by centre and adjusted for sex, energy

intake (log kJ), BMI (continuous), smoking status (dummy variable for former and current smokers), alcohol (quintiles of daily intake), physical activity (four levels) and education (five levels). Weights are from random effects analysis.

Conclusioni 1:

- ✓ In generale è emersa un'associazione positiva tra elevato consumo di carne totale e carne rossa e il rischio di DT2.
- ✓ Tra gli uomini è emersa una correlazione positiva tra il consumo elevato di carne totale, carne rossa, carne conservata e incidenza di DT2.
- ✓ Tra le donne è emersa una correlazione positiva tra il consumo elevato di carne totale, carne rossa, carne bianca e incidenza di DT2.

Conclusioni 2:

- ✓ Questo studio, che ha coinvolto una ampia coorte di adulti europei, ha fornito ulteriori prove del ruolo di carne e prodotti a base di carne come fattori di rischio per l'insorgere della patologia diabetica.
- ✓ Importanza dei risultati di questo studio e di altri studi sullo stesso argomento per l'identificazione di strategie sempre più efficaci di prevenzione primaria per il diabete di tipo 2.

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