Educational inequalities in cancer incidence in Turin, Italy

Teresa Spadea[a], Angelo d'Errico[a], Moreno Demaria[b], Fabrizio Faggiano[c], Sherri Pasian[a], Roberto Zanetti[d], Stefano Rosso[d], Piera Vicari[d] and Giuseppe Costa[a,e]

The objective of this study was to investigate the relationship between cancer incidence and socioeconomic status, and to examine the temporal trends in social inequalities in cancer risk. Educational differentials in the incidence of cancer (25 sites) among adult residents of Turin (Italy) were examined using data from the Turin Longitudinal Study and the Piedmont Cancer Registry. The relationship between cancer incidence and educational level was evaluated over three 5-year periods between 1985 and 1999 using Poisson models. An estimated 17% of malignancies among men in the low-educational group were attributable to education, whereas women with a low educational level were slightly protected. Less-educated men had higher risks of upper aero-digestive tract, stomach, lung, liver, rectal, bladder, central nervous system and ill-defined cancers, and lower risks of melanoma, kidney and prostate cancers. Women with lower educational levels were at higher risk of stomach, liver and cervical cancers, whereas they were less likely to be diagnosed with melanoma, ovarian and breast cancers. For most sites, the educational gradient in risk did not vary substantially over time. The educational inequalities in cancer incidence observed in this cohort appear similar in magnitude and direction to socioeconomic inequalities found in other Western countries; for some cancer sites results partly differ from the results of other studies, and require further investigation. A thorough understanding of the relative burden of well-documented causes of social inequalities in cancer risk is essential to address preventive measures and to direct future research on unexplained social differences. *European Journal of Cancer Prevention* 18:169–178 © 2009 Wolters Kluwer Health | Lippincott Williams & Wilkins.

European Journal of Cancer Prevention 2009, **18**:169–178

Keywords: cancer incidence, education, Italy, social inequalities, socioeconomic factors, temporal trends

[a]Regional Epidemiology Unit, ASL TO3 Piedmont Region, [b]Environmental Epidemiology Unit, ARPA Piedmont Region, Grugliasco, [c]Department of Experimental and Clinical Medicine, Avogadro University, Novara, [d]Piedmont Cancer Registry, CPO Piedmont Region, Turin and [e]Department of Public Health and Microbiology, University of Turin, Italy

Correspondence to Dr Teresa Spadea, MSc, MPhil, Servizio di Epidemiologia ASL TO3, via Sabaudia 164, 10095 Grugliasco (TO), Italy
Tel: +39 11 40188334; fax: +39 11 40188201;
e-mail: teresa.spadea@epi.piemonte.it

Received 4 July 2008 **Accepted** 27 November 2008

Introduction

The relationship between cancer incidence and socioeconomic status (SES) has been extensively discussed (Faggiano *et al.*, 1997). According to the literature, the most disadvantaged groups have significantly higher risks for some common cancers, especially in industrialized countries; excesses have been reported for lung, stomach, upper aero-digestive tract (UADT) and cervical cancers. The relationship is apparently direct for colon cancer, bone neoplasm, melanoma, breast and ovarian cancer. For all other cancers, the available evidence appears inconsistent.

In Italy, early studies conducted in the 1980s included a hospital case–control study (20 cancer sites, about 9000 cases) (La Vecchia *et al.*, 1992) and a study using data from the Piedmont Cancer Registry (12 sites, about 8000 cases) (Faggiano *et al.*, 1994). Many known educational gradients in cancer incidence were confirmed, but the evidence remained inconclusive for some sites, such as the central nervous system (CNS), lymphohemopoietic system, kidney and testis. Later, more in-depth studies evaluated the role of different social factors after adjusting for other known determinants, but mainly for colorectal and breast cancers (Barbone *et al.*, 1996; Tavani *et al.*, 1997, 1999; Pisa *et al.*, 2000). In these studies the social gradient appeared similar irrespective of the indicator used.

The most recent data on health and lifestyle in Italy reveal important changes in the social distribution of certain behaviours known to be associated with the risk of cancer. In particular, a high-fat diet lacking in vegetables, smoking and not breast-feeding have become more prevalent among lower socioeconomic classes (Federico *et al.*, 2004; Iannucci *et al.*, 2004; Turrini *et al.*, 2004), whereas they had been more common among higher classes. Moreover, in several European countries,

 DOI: 10.1097/CEJ.0b013e3283265bc9

differentials in the incidence of certain cancers have widened and in some cases inverted, generally to the disadvantage of the lower classes (Pukkala and Weiderpass, 1999; Hemminki and Li, 2003).

The aim of this study was to investigate the relationship between cancer incidence in adulthood and educational level among residents of Turin, Piedmont (north-western Italy) during 1985–1999; and to examine changes over time in the educational differentials in cancer incidence. As the study period spans 15 years, this analysis had greater statistical power than previous studies in Italy, and less common sites for which the literature is inconclusive could be included.

Methods

One source of data was the Turin Longitudinal Study (Office of National Statistics, 2001), which was created during the 1980s for the surveillance of health inequalities; for the nearly 800 000 people in the Turin Population Register (TPR), sociodemographic information is obtained from population censuses and health information from various sources. The Piedmont Cancer Registry, the other data source, has been collecting data on incident cancer cases among Turin residents since 1985 (Zanetti *et al.*, 1997). This study began with Turin residents between 30 and 74 years of age who were present in the TPR on 1 January 1985. The annual rate of emigration from Turin during the study period, which ended on 31 December 1999, was about 2% of the study population. New residents and deceased individuals were entered or removed from the study as of the date the event was recorded in the TPR.

Of the 84 285 incident cancer cases that occurred during the study period among 79 671 residents, 98.7% were linked to the TPR. Only the first diagnosis was considered for metachronous cancer, and the second for cutaneous epithelial cancer. A first diagnosis of a metastasis, with no previous registration of the primary cancer, was considered an ill-defined cancer site; 422 cases of in-situ breast carcinoma were included as an indicator of access to breast screening programs. There were 25 791 male cases and 22 433 female cases after excluding those that did not meet the age criterion at first diagnosis, chosen because the incidence of adulthood cancers is low before the age of 30 years and diagnoses may be less accurate among elderly people.

The SES indicator was educational level, a characteristic that accurately describes an individual's access to the limited resources in society, such as goods, services and knowledge (Krieger *et al.*, 1997). It is sufficiently stable after age 30, allowing the entire population to be classified, and it was found to be reliably reported in the Turin Longitudinal Study (unpublished data). The most recently available census information on educational attainment (1981 or 1991) was used to create three categories: low (primary school or less), intermediate (middle school) and high (at least high school), the reference group in the analyses.

The distribution of cancer cases by site, classified according to ICD-IX codes of first diagnosis, is reported for men and women in Table 1. In the analysis by cancer site, 451 male cases and 716 female cases of cancer in other sites were excluded (about 2 and 3% of the total, respectively).

All analyses were conducted separately for men and women by using Poisson models to estimate the relative risk (RR) of developing cancer in educational groups, adjusted for age (5-year categories) and area of birth (north-western, north-eastern, central, southern Italy and the islands; foreign country), a strong confounder in the association between education and health. A synthetic absolute measure of the excess risk attributable to educational level was computed as the percentage of cases avoidable if the whole population had the same incidence rates as in the highest educational group (attributable risk among the exposed). Temporal changes were examined over three 5-year periods between 1985 and 1999 for those sites with a total number of cases constituting at least 2% of the incident cases in the overall study period. The effect of time on the risk of cancer was assessed with an interaction term between period and educational level. The analyses were performed by using SAS (SAS Institute, 1999).

Results

The RR of cancer by educational level over the entire study period, adjusted for age and area of birth, are reported in Table 2. An estimated 13% of all malignancies among men with middle-school education or less was attributable to educational level, whereas women with primary-school education or less were slightly protected.

Compared to men with at least high-school education, the overall risk of developing cancer was 21% higher among men in the low-educational group and 18% higher in the intermediate. Men with primary educational level or less had a two-fold increased risk for UADT and stomach cancers, as well as significantly higher risks for lung (RR=1.75), liver (RR=1.53), ill-defined (RR=1.40), CNS (RR=1.39), rectal (RR=1.27) and bladder (RR=1.11) cancers. With the exception of CNS, these cancers were also significantly more likely among men with an intermediate educational level, with a clear 'dose–response' effect for UADT, stomach and lung. Men with lower educational levels were at significantly lower risk of melanoma and prostate cancer; and those with primary educational level or less also had a

Table 1 Distribution of cancer cases by site and sex

		Men		Women	
ICDIX code	Site	*n*	%	*n*	%
140–208, 233	All malignancies (excluding code 173)	25 791	100.0	22 433	100.0
140–149, 150, 161	Lip, oral cavity, pharynx, oesophagus and larynx (UADT)	2414	9.4	452	2.1
151	Stomach	1408	5.5	705	3.2
153	Colon	2061	8.0	1778	8.1
154	Rectum, rectosigmoid junction and anus	1106	4.3	860	3.9
155–156	Liver, gallbladder and bile ducts	1311	5.1	722	3.3
157	Pancreas	646	2.5	496	2.3
162	Trachea, bronchus and lung	5799	22.5	1171	5.3
163	Pleura	134	0.5	72	0.3
170–171	Bone and soft tissues	143	0.6	155	0.7
172	Melanoma	478	1.9	594	2.7
174	Breast	–	–	7771	35.3
180	Cervix uteri	–	–	736	3.3
182	Body of uterus	–	–	1246	5.7
183	Ovary	–	–	1074	4.9
185	Prostate	2307	8.9	–	–
186	Testis	190	0.7	–	–
188	Bladder	3203	12.4	610	2.8
189	Kidney and urinary organs	937	3.6	411	1.9
191–192	Central nervous system	497	1.9	365	1.7
158–159, 164–165, 194–199	Ill-defined cancers, including metastatic tumours	873	3.4	630	2.9
200, 202	NonHodgkin lymphomas	877	3.4	692	3.1
201	Hodgkin's disease	137	0.5	115	0.5
203	Multiple myeloma	277	1.1	235	1.1
204–208	Leukemias	542	2.1	405	1.8
233	In-situ breast carcinoma	–	–	422	–

Turin, 1985–1999.
UADT, upper aero-digestive tract.

20% lower risk of kidney cancer. None of the other cancers was associated with educational level, although the 50% higher risk of Hodgkin's disease among men in the intermediate group was marginally significant. The percentage of cases in the two lower educational groups attributable to education was particularly high for stomach (40%), UADT (37%) and lung (35%) cancers.

Women with primary-school education or less had an 11% lower overall risk of developing cancer during the study period, compared to women with at least high-school education. Increased risks were found for cervical and liver cancers in both the low (RR=1.95 and RR=1.44, respectively) and intermediate (RR=1.74 and RR=1.40) groups. Women in the low-educational group were also at significantly higher risk of stomach cancer (RR=1.59), and at lower risk of being diagnosed with ovarian (RR=0.82) and breast (RR=0.74) cancers. A 'dose–response' effect was apparent for melanoma (RR=0.44 and RR=0.68 in the low and intermediate educational groups) and for in-situ breast cancer (RR=0.41 and RR=0.71, respectively). A marginally significant increased risk was observed for bladder (30% higher), ill-defined (40%) and liver (40%) cancers among women in the intermediate group.

The temporal trends in the cancer risks among men by educational level are presented in Table 3. An increase in the educational gradient is particularly evident for rectal and bladder cancer, whereas a lower risk of colon cancer in the first period disappeared over time. The incidence of kidney cancer was not associated with educational level in the first period; however, men with primary-school education or less were at significantly lower risk (RR=0.70) in the last period. For these sites, the interaction between period and educational level was statistically significant at the 95% level. Finally, nonsignificant increases over time in the risks of liver and ill-defined cancers were observed in the low-educational group.

Among women with middle-school education or less, the risks of stomach and liver cancers observed in the first period were markedly lower by the last period (Table 4), whereas the risk of cervical cancer increased, particularly in the intermediate-educational group (from RR=1.49 to RR=2.08). Women in the low-educational group were also increasingly less likely (from 15 to 50%) to be diagnosed with in-situ breast cancer, compared with higher educated women. The interaction between period and educational level, however, was not statistically significant for any of these cancers.

Table 2 Relative risks of cancer by site, sex and level of education

		Sex					
		Men			Women		
Site		High	Medium	Low	High	Medium	Low
All malignancies	*n*	5241	6538	14 012	4019	5877	12 537
	RR	1	1.18	1.21	1	1.01	0.89
	95% CI		1.14–1.22	1.17–1.25		0.97–1.06	0.85–0.92
UADT	*n*	382	568	1464	69	132	251
	RR	1	1.45	1.96	1	1.28	1.07
	95% CI		1.27–1.65	1.74–2.21		0.95–1.71	0.80–1.42
Stomach	*n*	196	314	898	74	125	506
	RR	1	1.51	2.02	1	1.13	1.59
	95% CI		1.27–1.81	1.72–2.38		0.84–1.50	1.23–2.07
Colon	*n*	478	563	1020	267	426	1085
	RR	1	1.11	0.93	1	0.99	0.93
	95% CI		0.98–1.25	0.83–1.04		0.85–1.15	0.80–1.07
Rectum	*n*	214	294	598	115	175	570
	RR	1	1.30	1.27	1	0.96	1.16
	95% CI		1.09–1.56	1.07–1.50		0.75–1.21	0.94–1.43
Liver	*n*	187	325	799	65	158	499
	RR	1	1.55	1.53	1	1.40	1.44
	95% CI		1.30–1.86	1.29–1.80		1.05–1.87	1.10–1.88
Pancreas	*n*	154	140	352	67	126	303
	RR	1	0.85	0.97	1	1.14	1.02
	95% CI		0.67–1.06	0.80–1.19		0.84–1.53	0.77–1.35
Lung	*n*	866	1428	3505	181	326	664
	RR	1	1.54	1.75	1	1.11	0.89
	95% CI		1.41–1.67	1.62–1.89		0.92–1.33	0.75–1.06
Pleura	*n*	34	36	64	9	19	44
	RR	1	1.01	0.90	1	1.36	1.50
	95% CI		0.63–1.62	0.58–1.41		0.61–3.03	0.70–3.19
Bone	*n*	38	39	66	29	43	83
	RR	1	1.07	1.13	1	1.16	0.97
	95% CI		0.68–1.67	0.73–1.77		0.72–1.87	0.60–1.55
Melanoma	*n*	227	124	127	197	168	229
	RR	1	0.55	0.33	1	0.68	0.44
	95% CI		0.44–0.69	0.26–0.42		0.55–0.84	0.35–0.55
Breast	*n*	–	–	–	1680	2202	3889
	RR				1	0.95	0.74
	95% CI					0.89–1.01	0.69–0.78
Cervix uteri	*n*	–	–	–	93	193	450
	RR				1	1.74	1.95
	95% CI					1.35–2.24	1.52–2.49
Body of uterus	*n*	–	–	–	178	313	755
	RR				1	1.10	1.09
	95% CI					0.91–1.32	0.92–1.30
Ovary	*n*	–	–	–	205	289	580
	RR				1	0.97	0.82
	95% CI					0.81–1.17	0.69–0.98
Prostate	*n*	637	580	1090	–	–	–
	RR	1	0.83	0.70			
	95% CI		0.74–0.93	0.63–0.78			
Testis	*n*	90	58	42	–	–	–
	RR	1	0.86	0.88			
	95% CI		0.62–1.21	0.58–1.34			
Bladder	*n*	649	859	1695	79	175	356
	RR	1	1.23	1.11	1	1.30	0.98
	95% CI		1.11–1.37	1.01–1.22		1.00–1.70	0.76–1.27
Kidney	*n*	257	255	425	61	96	254
	RR	1	0.96	0.80	1	1.02	1.07
	95% CI		0.80–1.14	0.67–0.94		0.73–1.40	0.79–1.44
CNS	*n*	97	125	275	60	71	234
	RR	1	1.24	1.39	1	0.85	1.10
	95% CI		0.95–1.62	1.08–1.78		0.60–1.20	0.80–1.50
Ill-defined cancers	*n*	161	217	495	80	169	381
	RR	1	1.28	1.40	1	1.40	1.27
	95% CI		1.04–1.57	1.16–1.70		1.07–1.84	0.98–1.64
NonHodgkin lymphomas	*n*	231	228	418	106	174	412
	RR	1	0.95	0.89	1	1.17	1.05
	95% CI		0.79–1.15	0.75–1.06		0.91–1.49	0.83–1.33
Hodgkin's disease	*n*	39	56	42	33	35	47
	RR	1	1.50	0.86	1	1.05	0.79
	95% CI		0.99–2.27	0.52–1.40		0.65–1.71	0.46–1.34

Table 2 ***(continued)***

Site		Sex					
		Men			Women		
		High	Medium	Low	High	Medium	Low
Multiple myeloma	*n*	56	70	151	35	58	142
	RR	1	1.15	1.11	1	1.01	0.84
	95% CI		0.81–1.64	0.80–1.54		0.66–1.54	0.57–1.25
Leukemias	*n*	132	152	258	55	89	261
	RR	1	1.08	0.87	1	1.17	1.35
	95% CI		0.85–1.37	0.69–1.10		0.83–1.64	0.98–1.86
Breast (*in situ*)	*n*	–	–	–	130	128	164
	RR				1	0.71	0.41
	95% CI					0.55–0.91	0.32–0.53

Turin, 1985–1999.
CI, confidence interval; CNS, central nervous system; UADT, upper aero-digestive tract.

Table 3 Relative risks of cancer by site, period and level of education

Site		Years								
		1985–1989			1990–1994			1995–1999		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
All malignancies	*n*	1447	1863	4620	1630	2163	4616	2144	2495	4741
	RR	1	1.14	1.20	1	1.25	1.30	1	1.16	1.16
	95% CI		1.06–1.22	1.13–1.28		1.18–1.34	1.23–1.38		1.10–1.23	1.10–1.23
UADT	*n*	116	187	569	120	186	493	145	192	395
	RR	1	1.44	2.03	1	1.50	2.10	1	1.39	1.70
	95% CI		1.14–1.82	1.65–2.50		1.19–1.89	1.70–2.60		1.12–1.73	1.38–2.09
Stomach	*n*	66	101	343	60	102	287	69	110	265
	RR	1	1.35	1.88	1	1.62	2.22	1	1.57	1.93
	95% CI		0.99–1.84	1.43–2.47		1.18–2.23	1.66–2.97		1.16–2.13	1.45–2.57
Colon	*n*	155	180	297	135	165	334	187	217	388
	RR	1	1.03	0.73	1	1.15	1.12	1	1.14	1.00
	95% CI		0.83–1.28	0.60–0.90		0.92–1.45	0.90–1.38		0.93–1.38	0.82–1.21
Rectum	*n*	74	85	185	59	112	198	80	96	212
	RR	1	1.02	0.94	1	1.81	1.57	1	1.22	1.44
	95% CI		0.74–1.39	0.71–1.25		1.32–2.48	1.15–2.14		0.90–1.64	1.09–1.91
Liver	*n*	49	93	218	66	118	270	72	114	310
	RR	1	1.62	1.39	1	1.59	1.45	1	1.49	1.80
	95% CI		1.14–2.29	1.01–1.92		1.17–2.15	1.09–1.93		1.11–2.00	1.36–2.36
Pancreas	*n*	36	46	118	52	45	120	66	49	114
	RR	1	1.11	1.14	1	0.81	1.03	1	0.72	0.81
	95% CI		0.71–1.71	0.78–1.69		0.54–1.21	0.72–1.46		0.50–1.04	0.58–1.14
Lung	*n*	270	454	1276	274	474	1144	322	500	1083
	RR	1	1.46	1.70	1	1.61	1.83	1	1.54	1.67
	95% CI		1.25–1.70	1.49–1.95		1.39–1.87	1.60–2.11		1.34–1.77	1.47–1.91
Melanoma	*n*	43	26	39	62	34	34	119	64	54
	RR	1	0.58	0.43	1	0.57	0.34	1	0.57	0.32
	95% CI		0.35–0.94	0.27–0.70		0.37–0.87	0.22–0.55		0.42–0.77	0.22–0.46
Prostate	*n*	111	107	231	175	151	303	350	320	551
	RR	1	0.83	0.73	1	0.78	0.72	1	0.88	0.77
	95% CI		0.64–1.08	0.58–0.93		0.63–0.97	0.59–0.87		0.76–1.03	0.66–0.88
Bladder	*n*	187	220	528	205	291	588	254	345	571
	RR	1	1.03	1.01	1	1.33	1.25	1	1.34	1.12
	95% CI		0.85–1.25	0.85–1.20		1.11–1.59	1.05–1.48		1.14–1.58	0.95–1.31
Kidney	*n*	55	72	151	88	90	143	112	92	130
	RR	1	1.16	1.05	1	0.98	0.77	1	0.85	0.70
	95% CI		0.82–1.65	0.76–1.45		0.73–1.31	0.57–1.02		0.65–1.13	0.53–0.92
Ill-defined cancers	*n*	58	81	187	58	88	182	44	48	126
	RR	1	1.22	1.17	1	1.43	1.43	1	1.10	1.55
	95% CI		0.87–1.72	0.86–1.59		1.03–2.00	1.04–1.96		0.73–1.66	1.07–2.25
NonHodgkin lymphomas	*n*	41	54	112	82	75	149	106	97	157
	RR	1	1.19	1.06	1	0.89	0.94	1	0.93	0.90
	95% CI		0.79–1.78	0.72–1.56		0.65–1.23	0.70–1.26		0.70–1.22	0.68–1.19

Turin, men.
CI, confidence interval; UADT, upper aero-digestive tract.

Table 4 Relative risks of cancer by site, period and level of education

		Years								
		1985–1989			1990–1994			1995–1999		
Site		High	Medium	Low	High	Medium	Low	High	Medium	Low
All malignancies	*n*	926	1697	4043	1266	1953	4152	1809	2209	4303
	RR	1	1.09	0.94	1	1.06	0.94	1	0.97	0.89
	95% CI		1.00–1.18	0.87–1.01		0.98–1.14	0.88–1.01		0.91–1.03	0.83–0.94
UADT	*n*	23	33	93	21	48	86	25	51	70
	RR	1	0.88	1.06	1	1.50	1.17	1	1.49	0.96
	95% CI		0.52–1.52	0.65–1.74		0.89–2.52	0.70–1.95		0.92–2.42	0.58–1.58
Stomach	*n*	19	53	198	20	37	164	32	35	142
	RR	1	1.61	1.84	1	1.16	1.74	1	0.84	1.35
	95% CI		0.95–2.72	1.13–3.00		0.67–2.00	1.07–2.84		0.52–1.37	0.87–2.08
Colon	*n*	74	133	322	79	128	356	114	165	401
	RR	1	0.97	0.79	1	0.98	1.00	1	1.02	1.04
	95% CI		0.73–1.29	0.61–1.03		0.74–1.30	0.77–1.30		0.81–1.30	0.82–1.30
Rectum	*n*	30	49	200	38	63	201	47	62	168
	RR	1	0.87	1.09	1	1.03	1.27	1	0.95	1.08
	95% CI		0.55–1.37	0.73–1.63		0.69–1.55	0.88–1.84		0.65–1.39	0.76–1.55
Liver	*n*	14	53	150	16	49	175	35	56	174
	RR	1	1.90	1.57	1	1.79	2.19	1	1.03	1.11
	95% CI		1.05–3.43	0.90–2.75		1.02–3.16	1.29–3.73		0.67–1.57	0.75–1.64
Pancreas	*n*	22	33	93	16	43	101	29	50	109
	RR	1	0.77	0.70	1	1.65	1.42	1	1.18	1.14
	95% CI		0.45–1.33	0.43–1.15		0.93–2.94	0.81–2.47		0.74–1.88	0.73–1.79
Lung	*n*	49	103	233	51	104	217	81	119	214
	RR	1	1.15	0.89	1	1.28	1.10	1	0.97	0.76
	95% CI		0.81–1.62	0.64–1.23		0.91–1.79	0.79–1.52		0.73–1.29	0.58–1.00
Melanoma	*n*	30	33	59	59	56	78	108	79	91
	RR	1	0.70	0.48	1	0.72	0.50	1	0.72	0.48
	95% CI		0.42–1.15	0.29–0.78		0.50–1.05	0.34–0.74		0.53–0.97	0.35–0.68
Breast	*n*	376	624	1227	564	746	1269	733	821	1382
	RR	1	1.04	0.81	1	0.95	0.72	1	0.93	0.78
	95% CI		0.91–1.18	0.71–0.91		0.85–1.06	0.64–0.80		0.84–1.03	0.71–0.87
Cervix uteri	*n*	29	63	192	29	58	149	33	72	106
	RR	1	1.49	1.89	1	1.68	2.06	1	2.08	1.65
	95% CI		0.96–2.32	1.25–2.87		1.07–2.65	1.32–3.21		1.37–3.17	1.05–2.59
Body of uterus	*n*	49	102	252	50	109	257	78	102	241
	RR	1	1.12	0.98	1	1.34	1.32	1	0.94	1.08
	95% CI		0.80–1.58	0.71–1.34		0.96–1.88	0.96–1.82		0.70–1.27	0.82–1.43
Ovary	*n*	44	85	189	62	93	191	99	110	196
	RR	1	1.13	0.92	1	1.01	0.93	1	0.90	0.75
	95% CI		0.78–1.63	0.65–1.30		0.73–1.40	0.68–1.27		0.68–1.18	0.57–1.00
Bladder	*n*	21	48	108	27	59	103	30	68	144
	RR	1	1.19	0.87	1	1.32	0.93	1	1.42	1.22
	95% CI		0.71–2.00	0.54–1.42		0.84–2.10	0.59–1.46		0.92–2.19	0.81–1.85
Kidney	*n*	15	29	76	20	24	89	25	41	88
	RR	1	1.09	1.18	1	0.75	1.06	1	1.18	1.07
	95% CI		0.58–2.05	0.66–2.11		0.41–1.37	0.63–1.80		0.71–1.96	0.66–1.76
Ill-defined cancers	*n*	27	70	154	30	64	122	23	35	105
	RR	1	1.48	1.12	1	1.48	1.18	1	1.07	1.38
	95% CI		0.95–2.32	0.73–1.72		0.95–2.29	0.76–1.83		0.63–1.82	0.85–2.25
NonHodgkin lymphomas	*n*	20	45	122	36	70	134	50	59	156
	RR	1	1.42	1.23	1	1.34	1.01	1	0.95	1.14
	95% CI		0.84–2.42	0.74–2.03		0.89–2.02	0.67–1.51		0.65–1.39	0.79–1.64
Breast (*in situ*)	*n*	7	7	13	34	35	57	89	85	94
	RR	1	0.77	0.85	1	0.73	0.58	1	0.82	0.50
	95% CI		0.26–2.24	0.30–2.40		0.45–1.17	0.36–0.93		0.61–1.12	0.36–0.70

Turin, women.
CI, confidence interval; UADT, upper aero-digestive tract.

Discussion

Over the entire study period, 20% excess risk of cancer among men with lower educational levels was observed. These men had significantly higher risks of UADT, stomach, lung and liver cancers; they were also at higher risk for CNS, rectal, bladder and ill-defined cancers. The educational gradients were less pronounced among women, with the exception of cervical and breast cancers, and liver and stomach cancers, for which the gradients were similar to those observed among men. For most sites, the risk gradient did not vary substantially over time, apart from an increase in the risks of rectal, bladder, ill-defined and liver cancers among men and of cervical cancer among women; and a decrease in the risk of kidney cancer among men, and of stomach and liver cancers among women. A direct gradient was confirmed for melanoma, prostate, ovarian and breast cancers, which remained stable over time.

For many sites, particularly UADT, lung and bladder, a large part of the social gradient is likely to be mediated by the social distribution of smoking, the risk factor accounting for the highest attributable fraction (D'Avanzo *et al.*, 1995; Simonato *et al.*, 2001), as reported in several studies (Faggiano *et al.*, 1997; Hemminki and Li, 2003). Only a small proportion appears to have been explained by social differences in occupational exposures (Kogevinas *et al.*, 2003; Richiardi *et al.*, 2004). Alcohol consumption has an inverse social gradient in the male Italian population, and is associated with some UADT cancers. The social distribution of these risk factors differs among Italian women, showing either a direct gradient or none at all (Vannoni, 2004); in particular, the gradual reversal of the social gradient in smoking since the 1990s (Federico *et al.*, 2004) is not yet evident in cancer risks.

The inverse educational gradient observed for stomach cancer is consistent with Italian data (Ferraroni *et al.*, 1989), but appears to be steeper than that found in Northern Europe (Faggiano *et al.*, 1997). This may be explained by the higher prevalence of *Helicobacter pylori* infection in Italy, which is inversely associated with educational level (Palli *et al.*, 1993; Russo *et al.*, 1999). A similar explanation holds for liver cancer, for which an inverse social distribution of HBV and HCV infection (together with alcohol consumption) has been found in Italy (Intonazzo *et al.*, 1991; Campello *et al.*, 2002). In countries with a high prevalence of HBV, such as Italy, the social gradient in cancer risk appears steeper and more consistent (Ferraroni *et al.*, 1989; Faggiano *et al.*, 1997; Pearce and Bethwaite, 1997) than that found in countries with a low prevalence, such as Finland, Sweden, Switzerland and Denmark (Faggiano *et al.*, 1997).

For rectal cancer, either no gradient or a slight inverse association has been reported (Faggiano *et al.*, 1997; Tavani *et al.*, 1999; Hemminki and Li, 2003). An Italian study observed a strong direct association between rectal cancer and education only among women (Pisa *et al.*, 2000), whereas we found higher risks only among men with lower educational levels. For colon cancer, a weak direct association has also been consistently reported (Van Loon *et al.*, 1995; Hemminki and Li, 2003) in Italy (Ferraroni *et al.*, 1989; Tavani *et al.*, 1999; Pisa *et al.*, 2000), whereas we found no association over the entire study period. The disappearance of the protection observed in the low-educational groups over time between 1985 and 1989 is consistent with the increasing economic well-being during the 1970s and 1980s in Turin, and with the inversion of the social distribution of the main risk factors, such as alcohol, diet, physical inactivity, obesity (The DAFNE Project, 2004; Vannoni, 2004). Similar changes occurred a decade earlier in the United States (Steenland *et al.*, 2002) and Sweden (Hemminki and Li, 2003). The difference in the SES gradients for colon and rectal cancers may be attributable to the higher sensitivity of screening tests in detecting left-sided adenomas compared with right-sided adenomas (Gupta *et al.*, 2005), already in common use during the 1980s among higher social classes.

A direct educational gradient in kidney cancer among men became evident in the last period. An evaluation of absolute rates revealed that it was attributable to an increase in incidence among higher educated men, possibly related to new diagnostic techniques, leading to earlier diagnosis among asymptomatic patients (Bos *et al.*, 2000); the absence of a similar effect among women is not clear. The international literature is contradictory, with reports of both direct (Pukkala and Teppo, 1986; Lynge and Thygesen, 1990; La Vecchia *et al.*, 1992) and inverse relationships (Mellemgaard *et al.*, 1994; Schlehofer *et al.*, 1995), likely owing to the low attributable risks of the main risk factors such as smoking, diet, obesity and hypertension (Chow *et al.*, 1996).

The strong protection against melanoma in lower SES groups is likely to be attributable both to greater recreational exposure to the sun (Zanetti *et al.*, 1992) and to earlier diagnosis among higher social classes (Montella *et al.*, 2002).

The higher risks observed for cancers with an ill-defined site among people with lower educational levels may be owing to greater delay and less accuracy in diagnosis. Several studies showed that diagnostic delay (Ciccone *et al.*, 2000) and more advanced disease stages (Vineis *et al.*, 1993) are more frequent among lower social classes in Turin.

The lower risk of prostate cancer among less-educated men is consistent with reports from other countries (Lund Nilsen *et al.*, 2000; Hemminki and Li, 2003; Steenland *et al.*, 2004), and is likely to be associated with the performance of screening, a more common practice among higher social classes (Gilligan *et al.*, 2004). Over the past 20 years, in fact, the incidence of prostate cancer in industrialized countries has been increasing, and the frequency of advanced stages at diagnosis has decreased among higher-educated men (Harvey and Kravdal, 1997; Tarman *et al.*, 2000).

An overall level of protection of 26% from breast cancer among less-educated women is consistent with Italian (La Vecchia *et al.*, 1992) and international data (Faggiano *et al.*, 1997). Reproductive and hormone-related risk factors, for which PAR is an estimated 40% in Italy (Tavani *et al.*, 1997; Colditz *et al.*, 2006), are more prevalent in higher social classes (Dos Santos Silva and Beral, 1997) and largely explain the social differential in incidence, although a direct social gradient has been found even after adjusting for these factors (Barbone *et al.*, 1996; Dano *et al.*, 2004). There is increasing evidence that a diet low in fat and red meat, and rich in vegetables, is protective (Sieri *et al.*, 2004), whereas obesity is a strong predictor of postmenopausal breast cancer (Lahmann *et al.*, 2004). Given that the prevalence of these risk factors is increasing among less-educated women, especially obesity (Vannoni, 2004), not breast-feeding (Iannucci *et al.*, 2004), and unhealthy diet (Vannoni *et al.*, 2003; Turrini *et al.*, 2004), the social gradient in incidence is likely to change direction.

Of particular interest is the overall increase in the incidence of in-situ breast cancer, from which less-educated women seem to be protected. This is likely to be the effect of the population screening programme in Turin since 1992 (Buiatti *et al.*, 2003), to which educated women have shown higher adherence (Mancini *et al.*, 2004). Studies from the United States and United Kingdom confirmed the positive association between breast cancer incidence and SES, and showed that it is inverted at advanced disease stages (Schwartz *et al.*, 2003; Yabroff and Gordis, 2003; Adams *et al.*, 2004). The slight protection from ovarian cancer found among less-educated women reflects the same determinants as breast cancer (Bosetti *et al.*, 2001; La Vecchia, 2001).

To explain the strong inverse educational gradient in cervical cancer, both the social distribution of sexual behaviour, the most important risk factor for human papilloma virus (Bosch and de Sanjosé, 2003), and adherence to screening programs, which can prevent 80–90% of malignant tumours through the detection of precancerous lesions, must be considered (Segnan, 1997). Participation rates in screening programs consistently indicate that women in the lower social classes are less likely to undergo screening (Mancini *et al.*, 2004). Italian data on the social distribution of sexual behaviours and human papilloma virus prevalence are sparse, but international data indicate greater promiscuity in lower social classes (De Sanjose *et al.*, 1997).

Uterine cancer did not show a social gradient in our study, and international literature is inconsistent (Faggiano *et al.*, 1997). The main risk factors, which include reproductive behaviour, obesity, and oestrogen use (Cook *et al.*, 2006), suggest a direct social gradient; however, hysterectomy and voluntary abortion are both more prevalent among less-educated women in Italy (Spinelli *et al.*, 1999; Materia *et al.*, 2002), which may explain the absence of such an effect.

Less common cancers

The higher risk of CNS cancer observed among less-educated men contradicts previous findings in which either no association or a direct social gradient was reported (Faggiano *et al.*, 1997), although only for some cancer histotypes (Inskip *et al.*, 2003). The aetiology of cerebral tumours remains unclear, although several reports indicate associations with occupational exposures that cut across diverse social strata (e.g. physicians, dentists, fire-fighters, farmers, miners, metal workers) (Navas-Acien *et al.*, 2002; Pan *et al.*, 2005).

A higher risk of testicular cancer in upper social classes has been documented in Western countries (Faggiano *et al.*, 1997), although not consistently (Moller and Skakkebaek, 1996), together with a decrease over time owing to an increase in incidence among less-educated men (Hemminki and Li, 2003). Apart from cryptorchidism, which is more frequent among less-educated men (Moller and Shakkebaek, 1996), other risk factors are more widespread among educated men, such as reproductive factors, a small number of siblings, or high-fat diet during the 1980s (D'Amicis *et al.*, 1994; Dos Santos Silva and Beral, 1997; Garner *et al.*, 2005).

A direct social gradient reported for Hodgkin's lymphoma seems to vary in direction and intensity, depending on age at onset and histological type of tumour (Serraino *et al.*, 1991; Mueller and Grufferman, 2006).

Limitations

The results of this study are based on data derived from linkage between a well-established cancer registry and a census-based cohort. The most serious threat to the validity of our results is the potential selection bias owing to the lack of health information for people who left Turin during the study period. However, a previous study concluded that Turin emigrants were generally healthier and more likely to be single, but they did not differ significantly in SES compared with the stable population (Costa *et al.*, 1998). Another limitation was the lack of information on health-related risk factors at the individual level, which made it impossible to directly assess their impact on the SES gradient in cancer risk. We have, alternatively, commented on the coherence between the observed social gradients and the prevalence of the respective risk factors in SES groups, although this information is often incomplete.

Conclusion

Educational inequalities in cancer risk observed in this dynamic Italian cohort, in general, appear similar in magnitude and direction to those found in other Western countries. The gradient in the risks observed for rectal, colon, kidney and uterine cancers differs, in part, from the results of other studies, and requires further investigation.

The influence of educational level on cancer incidence seems to be greater among men, and an increase can be expected, given that many risk factors seem to be increasing among young people in lower social classes. This emphasizes the need to focus on measures for reducing social inequalities in these behavioural risk factors, especially during adolescence. The temporal changes in educational inequalities found for several sites suggest new hypotheses on the determinants, and on the role played by inequalities in access to early diagnosis (for kidney, breast, cervical and ill-defined cancers).

A thorough understanding of the relative burden of well-documented causes of social inequalities in cancer risk is essential to address preventive measures and to direct future research on unexplained social differences. This information can be partly obtained from studies conducted in other Western countries; however, a higher priority on surveillance studies of known lifestyle and biological risk factors for cancer in Italy is required, as a complete picture of the demographic, geographical and social pattern of these factors is still lacking. This knowledge would constitute the basis for predicting future trends in cancer risk and for designing and implementing suitable policies to tackle social inequalities.

Acknowledgements

The authors thank Cristina Scarciello for her assistance in editing the tables and the bibliography and Mark Kanieff for translating the first draft of the manuscript. This study was partially supported by a grant from the Italian Ministry of Health.

References

Adams J, White M, Forman D (2004). Are there socioeconomic gradients in stage and grade of breast cancer at diagnosis? Cross sectional analysis of UK cancer registry data. *BMJ* **329**:142.

Barbone F, Filiberti R, Franceschi S, Talamini R, Conti E, Montella M, *et al.* (1996). Socioeconomic status, migration and the risk of breast cancer in Italy. *Int J Epidemiol* **25**:479–487.

Bos SD, Mellema CT, Mensink J (2000). Increase in renal cell carcinoma in the northern part of the Netherlands. *Eur Urol* **37**:267–270.

Bosch FX, de Sanjosé S (2003). Chapter 1: Human papillomavirus and cervical cancer-burden and assessment of causality. *J Natl Cancer Inst Monogr* **31**:3–13.

Bosetti C, Negri E, Franceschi S, Pelucchi C, Talamini R, Montella M, *et al.* (2001). Diet and ovarian cancer risk: a case-control study in Italy. *Int J Cancer* **93**:911–915.

Buiatti E, Barchielli A, Bartolacci S, Federico M, De Lisi V, Bucchi L, *et al.* (2003). The impact of organised screening programmes on the stage-specific incidence of breast cancer in some Italian areas. *Eur J Cancer* **39**: 1776–1782.

Campello C, Poli A, Dal Molin G, Besozzi-Valentini F (2002). Seroprevalence, viremia and genotype distribution of hepatitis C virus: a community-based population study in northern Italy. *Infection* **30**:7–12.

Chow WH, McLaughlin JK, Mandel JS, Wacholder S, Niwa S, Fraumeni JF Jr (1996). Obesity and risk of renal cell cancer. *Cancer Epidemiol Biomarkers Prev* **5**:17–21.

Ciccone G, Prastaro C, Ivaldi C, Giacometti R, Vineis P (2000). Access to hospital care, clinical stage and survival from colorectal cancer according to socio-economic status. *Ann Oncol* **11**:1201–1204.

Colditz GA, Baer HJ, Tamimi RM (2006). Breast cancer. In: Schottenfeld D, Fraumeni JF, editors. *Cancer epidemiology and prevention*. Oxford: Oxford University Press. pp. 995–1012.

Cook LS, Weiss NS, Doherty JA, Chen C (2006). Endometrial cancer. In: Schottenfeld D, Fraumeni JF, editors. *Cancer epidemiology and prevention*. Oxford: Oxford University Press. pp. 1027–1043.

Costa G, Cardano M, Demaria M (1998). Torino. Storie di salute in una grande città [Turin. Health stories in a big city]. Torino: Città di Torino, Osservatorio Socioeconomico Torinese, 51–52.

D'Amicis A, Faggiano F, Saba A (1994). La distribuzione sociale dello stato nutrizionale in Italia negli anni '80 [The social distribution of nutritional status in Italy in the '80s]. In: Costa G, Faggiano F, editors. *Equity in health in Italy*. Milano: Franco Angeli. pp. 199–210.

Dano H, Hansen KD, Jensen P, Petersen JH, Jacobsen R, Ewertz M, *et al.* (2004). Fertility pattern does not explain social gradient in breast cancer in Denmark. *Int J Cancer* **111**:451–456.

D'Avanzo B, La Vecchia C, Negri E, Decarli A, Benichou J (1995). Attributable risks for bladder cancer in northern Italy. *Ann Epidemiol* **5**:427–431.

De Sanjosé S, Bosch FX, Munoz N, Shah K (1997). Social differences in sexual behaviour and cervical cancer. In: Kogevinas M, Pearce N, Susser M, Boffetta P, editors. *Social inequalities and cancer*. Lyon: IARC (IARC Scientific Publication No 138). pp. 309–317.

Dos Santos Silva I, Beral V (1997). Socioeconomic differences in reproductive behaviour. In: Faggiano F, Partanen T, Kogevinas M, Boffetta P, editors. *Social inequalities and cancer*. Lyon: IARC (IARC Scientific Publications No 138). pp. 285–308.

Faggiano F, Zanetti R, Costa G (1994). Cancer risk and social inequalities in Italy. *J Epidemiol Community Health* **48**:447–452.

Faggiano F, Partanen T, Kogevinas M, Boffetta P (1997). Socioeconomic differences in cancer incidence and mortality. In: Kogevinas M, Pearce N, Susser M, Boffetta P, editors. *Social inequalities and cancer*. Lyon: IARC (IARC Scientific Publications No 138). pp. 65–176.

Federico B, Kunst AE, Vannoni F, Damiani G, Costa G (2004). Trends in educational inequalities in smoking in northern, mid and southern Italy, 1980–2000. *Prev Med* **39**:919–926.

Ferraroni M, Negri E, La Vecchia C, D'Avanzo B, Franceschi S (1989). Socioeconomic indicators, tobacco and alcohol in the aetiology of digestive tract neoplasms. *Int J Epidemiol* **18**:556–562.

Garner MJ, Turner MC, Ghadirian P, Krewski D (2005). Epidemiology of testicular cancer: an overview. *Int J Cancer* **116**:331–339.

Gilligan T, Wang S, Levin R, Kantoff PW, Avorn J (2004). Racial differences in screening for prostate cancer in the elderly. *Arch Intern Med* **164**: 1858–1864.

Gupta AK, Melton LJ, Petersen GM, Timmons LJ, Vege SS, Harmsen WS, *et al.* (2005). Changing trends in the incidence, stage, survival, and screen-detection of colorectal cancer: a population-based study. *Clin Gastroenterol Hepatol* **3**:150–158.

Harvey S, Kravdal O (1997). The importance of marital and socioeconomic status in incidence and survival of prostate cancer. An analysis of complete Norwegian birth cohorts. *Prev Med* **26**:623–632.

Hemminki K, Li X (2003). Level of education and the risk of cancer in Sweden. *Cancer Epidemiol Biomarkers Prev* **12**:796–802.

Iannucci L, Sabbadini LL, Sebastiani G (2004). L'allattamento al seno: trend e differenze territoriali [Breastfeeding: trend and geographical differences]. In: Sabbadini LL, Costa G, editors. *Statistical information and policies to promote health. Conference Proceedings, Rome 10–12 September 2002*. Roma: Istat. pp. 329–340.

Inskip PD, Tarone RE, Hatch EE, Wilcosky TC, Fine HA, Black PM, *et al.* (2003). Sociodemographic indicators and risk of brain tumours. *Int J Epidemiol* **32**:225–233.

Intonazzo V, La Rosa G, Massenti MF, Perna AM, Restivo E, Sferlazzo A, *et al.* (1991). Epidemiological aspects of hepatitis B in Palermo: changes in HBV spread. *Eur J Epidemiol* **7**:696–698.

Kogevinas MT, Mannetje A, Cordier S, Ranft U, Gonzalez CA, Vineis P, *et al.* (2003). Occupation and bladder cancer among men in Western Europe. *Cancer Causes Control* **14**:907–914.

Krieger N, Williams DR, Moss NE (1997). Measuring social class in U.S. public health research: concepts, methodologies, and guidelines. *Annu Rev Public Health* **18**:341–378.

Lahmann PH, Hoffman K, Naomi Allen N, Van Gils CH, Khaw KT, Tehard B, *et al.* (2004). Body size and breast cancer risk: findings from the European prospective investigation into cancer and nutrition (EPIC). *Int J Cancer* **111**:762–771.

La Vecchia C (2001). Epidemiology of ovarian cancer: a summary review. *Eur J Cancer Prev* **10**:125–129.

La Vecchia C, Negri E, Franceschi S (1992). Education and cancer risk. *Cancer* **70**:2935–2941.

Lund Nilsen TI, Johnsen R, Vatten LJ (2000). Socio-economic and lifestyle factors associated with the risk of prostate cancer. *Br J Cancer* **82**:1358–1363.

Lynge E, Thygesen L (1990). Occupational cancer in Denmark – Cancer incidence in the 1970 census population. *Scand J Work Environ Health* **16** (**Suppl 2**):1–35.

Mancini E, Segnan N, Ronco N (2004). I determinanti del ricorso allo screening dei tumori femminili [The determinants of attendance in female cancer screening]. In: Sabbadini LL, Costa G, editors. *Statistical information and policies to promote health. Conference Proceedings, Rome 10–12 September 2002*. Roma: Istat. pp. 353–365.

Materia E, Rossi L, Spadea T, Cacciani L, Baglio G, Cesaroni G, *et al*. (2002). Hysterectomy and socioeconomic position in Rome, Italy. *J Epidemiol Community Health* **56**:461–465.

Mellemgaard A, Engholm G, McLaughlin JK, Olsen JH (1994). Risk factors for renal cell carcinoma in Denmark. Role of socioeconomic status, tobacco use, beverages, and family history. *Cancer Causes Control* **5**:105–113.

Moller H, Skakkebaek NE (1996). Risks of testicular cancer and cryptorchidism in relation to socio-economic status and related factors: case-control studies in Denmark. *Int J Cancer* **66**:287–293.

Montella M, Crispo A, Grimaldi M, De Marco MR, Ascierto PA, Parasole R, *et al*. (2002). An assessment of factors related to tumor thickness and delay in diagnosis of melanoma in southern Italy. *Prev Med* **35**:271–277.

Mueller NE, Grufferman S (2006). Hodgkin lymphoma. In: Schottenfeld D, Fraumeni JF, editors. *Cancer epidemiology and prevention*. Oxford: Oxford University Press. pp. 872–897.

Navas-Acien A, Polla M, Gustavsson P, Plato N (2002). Occupation, exposure to chemicals and risk of gliomas and meningiomas in Sweden. *Am J Ind Med* **42**:214–227.

Office of National Statistics (2001). Longitudinal study newsletter no 24. Office of National Statistics and Centre for Longitudinal Study, University of London, London. pp. 2–3.

Palli D, Recarli A, Cipriani F, Sitas F, Forman D, Amadori D, *et al*. (1993). Helicobacter pylori antibodies in areas of Italy at varying gastric cancer risk. *Cancer Epidemiol Biomarkers Prev* **2**:37–40.

Pan SY, Ugnat AM, Mao Y (2005). The Canadian cancer registries epidemiology research group. Occupational risk factors for brain cancer in Canada. *J Occup Environ Med* **47**:704–717.

Pearce N, Bethwaite P (1997). Social class and male cancer mortality in New Zealand, 1984–1987. *N Z Med J* **110**:200–202.

Pisa FE, Barbone F, Montella M, Talamini R, La Vecchia C, Franceschi S (2000). Migration, socio-economic status and the risk of colorectal cancer in Italy. *Eur J Cancer Prev* **9**:409–416.

Pukkala E, Teppo L (1986). Socioeconomic status and education as risk determinants of gastrointestinal cancer. *Prev Med* **15**:127–138.

Pukkala E, Weiderpass E (1999). Time trends in socio-economic differences in incidence rates of cancers of the breast and female genital organs (Finland, 1971–1995). *Int J Cancer* **81**:56–61.

Richiardi L, Boffetta P, Simonato L, Forestiere F, Zambon P, Fortes C, *et al*. (2004). Occupational risk factors for lung cancer in men and women: a population-based case–control study in Italy. *Cancer Causes Control* **15**:285–294.

Russo A, Eboli M, Pizzetti P, Di Felice G, Ravagnani F, Spinelli P, *et al*. (1999). Determinants of *Helicobacter pylori* seroprevalence among Italian blood donors. *Eur J Gastroenterol Hepatol* **11**:867–873.

SAS Institute (1999). *The SAS system for Windows, release 8.01*. Cary, NC: SAS.

Schlehofer B, Heuer C, Blettner M, Niehoff D, Wahrendorf J (1995). Occupation, smoking and demographic factors, and renal cell carcinoma in Germany. *Int J Epidemiol* **24**:51–57.

Schwartz KL, Crossley-May H, Vigneau FD, Brown K, Banerjee M (2003). Race, socioeconomic status and stage at diagnosis for five common malignancies. *Cancer Causes Control* **14**:761–766.

Segnan N (1997). Socioeconomic status and cancer screening. In: Kogevinas M, Pearce N, Susser M, Boffetta P, editors. *Social inequalities and cancer*. Lyon: IARC (IARC Scientific Publication No 138). pp. 369–376.

Serraino D, Franceschi S, Talamini R, Barra S, Negri E, Carbone A, *et al*. (1991). Socio-economic indicators, infectious diseases and Hodgkin's disease. *Int J Cancer* **47**:352–357.

Sieri S, Krogh V, Pala V, Muti P, Micheli A, Evangelista A, *et al*. (2004). Dietary patterns and risk of breast cancer in the Ordet Cohort. *Cancer Epidemiol Biomarkers Prev* **13**:567–572.

Simonato L, Agudo A, Ahrens W, Benhamou E, Benhamou S, Boffetta P, *et al*. (2001). Lung cancer and cigarette smoking in Europe: an update of risk estimates and an assessment of inter-country heterogeneity. *Int J Cancer* **91**:876–887.

Spinelli A, Boccuzzo G, Grandolfo ME, Buratta V, Pediconi M, Donati S, *et al*. (1999). Evolution of voluntary interruption of pregnancy in Italy from its legalization until today. *Ann Ist Super Sanita* **35**:307–314.

Steenland K, Henley J, Thun M (2002). All-cause and cause-specific death rates by educational status for two million people in two American cancer society cohorts, 1959–1996. *Am J Epidemiol* **156**:11–21.

Steenland K, Rodriguez C, Mondul A, Calle EE (2004). Prostate cancer incidence and survival in relation to education (US). *Cancer Causes Control* **15**:939–945.

Tarman GJ, Kane CJ, Moul JW, Thrasher JB, Foley JP, Wilhite D, *et al*. (2000). Impact of socioeconomic status and race on clinical parameters of patients undergoing radical prostatectomy in an equal access health care system. *Urology* **56**:1016–1020.

Tavani A, Braga C, La Vecchia C, Negri E, Russo A, Franceschi S (1997). Attributable risk for breast cancer in Italy: education, family history and reproductive and hormonal factors. *Int J Cancer* **70**:159–163.

Tavani A, Fioretti F, Franceschi S, Gallus S, Negri E, Montella M, *et al*. (1999). Education, socioeconomic status and risk of cancer of the colon and rectum. *Int J Epidemiol* **28**:380–385.

The DAta Food NEtworking (DAFNE) Project (2004). European food availability databank based on household budget surveys. DAFNE Report III, 2004. Available at *http://www.nut.uoa.gr/english/*

Turrini A, De Carli A, D'Amicis A, Martines S, Orsini S (2004). Abitudini alimentari: tendenze evolutive nella popolazione e nei giovani [Dietary patterns: trends in the population and among young people]. In: Sabbadini LL, Costa G, editors. *Informazione statistica e politiche per la promozione della salute. Atti del convegno, Roma 10–12 settembre 2002*. Roma: Istat. pp. 45–60.

Van Loon AJ, Brug J, Goldbohm RA, Van den Brandt PA, Burg J (1995). Differences in cancer incidence and mortality among socio-economic groups. *Scand J Soc Med* **23**:110–120.

Vannoni F (2004). Gli stili di vita [Life styles]. In: Costa G, Spadea T, Cardano M, editors. Disuguaglianze di salute in Italia [Health inequalities in Italy]. *Epidemiol Prev* 28 (Suppl 3):64–74.

Vannoni F, Spadea T, Frasca G, Tumino R, Demaria M, Sacerdote C, *et al*. (2003). Association between social class and food consumption in the Italian Epic population. *Tumori* **89**:669–678.

Vineis P, Foriero G, Magnino A, Giacometti R, Ciccone G (1993). Diagnostic delay, clinical stage, and social class: a hospital based study. *J Epidemiol Community Health* **43**:229–231.

Yabroff KR, Gordis L (2003). Does stage at diagnosis influence the observed relationship between socioeconomic status and breast cancer incidence, case-fatality, and mortality? *Soc Sci Med* **57**:2265–2279.

Zanetti R, Franceschi S, Rosso S, Colonna S, Bidoli E (1992). Cutaneous melanoma and sunburns in childhood in a southern European population. *Eur J Cancer* **28A**:1172–1176.

Zanetti R, Rosso S, Vicari P, Foggetti R, Patriarca S, Prandi R, Gremo F (1997). Cancer incidence in Italy, Torino, 1988–1991. In: Parkin DM, Whelan SM, Ferlay J, Raymond I, Young J, editors. *Cancer incidence in five continents Vol. VII*. Lyon: IARC (IARC Scientific Publication No 143). pp. 558–561.