EUROPEAN JOURNAL OF CANCER 42 (2006) 234–242

available at www.sciencedirect.com

journal homepage: www.ejconline.com

Cancer survival in the elderly: Effects of socio-economic factors and health care system features (ELDCARE project)

Marina Vercelli[a,b,*], Roberto Lillini[a], Riccardo Capocaccia[c], Andrea Micheli[d], Jan Willem Coebergh[e,f], Mike Quinn[g], Carmen Martinez-Garcia[h], Alberto Quaglia[a], The ELDCARE Working Group[1]

[a]Descriptive Epidemiology Unit, National Cancer Research Institute, Cancer Registry Unit, Largo Rosanna Benzi, n.10, 16132 Genova, Italy
[b]Department of Health Sciences, Genova University, Genova, Italy
[c]National Centre of Epidemiology, Surveillance and Promotion of Health, National Institute of Health, Rome, Italy
[d]Descriptive Epidemiology and Public Health Planning Unit, National Cancer Institute, Milan, Italy
[e]Department of Public Health, Erasmus MC Rotterdam, The Netherlands
[f]Eindhoven Cancer Registry, Comprehensive Cancer Centre South, Eindhoven, The Netherlands
[g]National Cancer Intelligence Centre, Office for National Statistics, London, United Kingdom
[h]Granada Cancer Registry, Andalusian School of Public Health, Granada, Spain

ARTICLE INFO

Article history:
Received 29 June 2005
Accepted 5 July 2005
Available online 15 December 2005

Keywords:
ELDCARE
Elderly
Epidemiology
EUROCARE 3

ABSTRACT

The purpose of the ELDCARE project is to study differences in cancer survival for elderly patients by country, taking into account the socio-economic conditions and the characteristics of health care systems at the ecological level. Fifty-three European cancer registries, from 19 countries, participating in the EUROCARE 3 programme, collected information to compute relative survival on patients aged 65–84 years, diagnosed over the period 1990–1994. National statistics offices provided the macro-economic and labour force indicators (gross domestic product, total health expenditure, and proportion of people employed in the agriculture sector) as well as the features of national health care systems. Survival for several of the cancer sites had high positive Pearson's correlations (r) with the affluence indicators (usually $r > 0.7$), but survival for the poor prognosis cancers (lung, ovary, stomach) and for cervix uteri was not so well correlated. Among the medical resources considered, the number of computed tomography scanners was the variable most related to survival in the elderly; the number of total health practitioners in the country did not show any relationship. Survival was related to the marital status of elderly women more strongly than for men and younger people. The highest correlations of survival with the percentage of married elderly women in the population were for cancers of the rectum ($r = 0.79$) and breast ($r = 0.66$), while survival correlated negatively with the proportion of widows for

* Corresponding author: Tel.: +39 010 5600961; fax: +39 010 5600956.
E-mail address: marina.vercelli@istge.it (M. Vercelli).

[1] The ELDCARE Working Group: Austria: W. Oberaigner (Tyrol Cancer Registry); Czech Republic: J. Ajmová (Institute of Health Information and Statistics of the Czech Republic); Estonia: T. Aareleid, E. Palo (Estonian Cancer Registry); Finland: T. Hakulinen (Finnish Cancer Registry); France: P. Grosclaude (Tarn Cancer Registry); Germany: H. Ziegler (Saarland Cancer Registry); Iceland: L. Tryggvadottir (Icelandic Cancer Registry); Italy: M. Vercelli (Ligurian Cancer Registry IST, University of Genova); Norway: F. Langmark, A. Andersen (Norway Cancer Registry); Poland: M. Bielska-Lasota (Warsav Cancer Registry); Portugal: P.S. Pinheiro (South Portugal Cancer Registry); Slovakia: I. Pleško (National Cancer Registry of Slovakia); Slovenia: V. Pompe-Kirn, P. Ecimovic (Cancer Registry of Slovenia); Spain: C. Martinez-Garcia (Granada Cancer Registry); Sweden: T. Möller (Cancer Registry of Sweden); Switzerland: J-M. Lutz (Geneva Cancer Registry); The Netherlands: J.W.W. Coebergh (Eindhoven Cancer Registry); United Kingdom: M.J. Quinn (Office for National Statistics).

0959-8049/$ - see front matter
doi:10.1016/j.ejca.2005.07.032

most cancers. Being married or widowed is for elderly people, in particular elderly women, an important factor influencing psychological status, life habits and social relationships. Social conditions could play a major role in determining health outcomes, particularly in the elderly, by affecting access to health care and delay in diagnosis.

1. Introduction

The EUROCARE I and II studies, at the time of their publication the largest population-based studies investigating cancer survival in Europe, revealed important geographical variations in survival among European countries for all cancer sites [1,2]. The variation was, however, different in younger and older patients, depending on the general prognosis of each cancer [3].

In addition, very large and unexpected differences in survival between the elderly and younger adults were observed. Elderly patients, those aged 65 years or over, had much poorer survival rates than younger adults, particularly at one year after diagnosis. The relative disadvantage of elderly patients was more noticeable in women generally and for gynaecological cancers in particular [4,5].

These findings suggest a possible role played by stage of disease at presentation and the importance of social support as well as access to health care, all of which are strongly influenced by socio-economic factors. Influential experts in geriatric oncology consider that large systematic studies are warranted in two important areas: clinical response to cancer treatment in the presence of the normal physiological ageing process and co-morbidities; and the psychological resources and socio-economic support used by the elderly to cope with the effects of cancer and its treatment [6].

Very marked ecological correlations have been observed between some socio-economic factors and survival for patients of all ages combined for various cancers [3]. Other studies however, did not find a link between socio-economic factors and health outcomes in the elderly [7–9]. These contradictory results probably arise from the differences in the indicators used to measure health outcomes [10].

The ELDCARE project is an ecological study specifically planned to describe and understand the relationships between cancer survival in the elderly and both socio-economic conditions and the characteristics of health care systems in a large number of European countries.

The basis and the main features of this project have been described in a previous publication [11]. That paper focused on the description of the database and on the analysis of the relationships between cancer survival and various characteristics of the health systems in different countries. The present paper examines the relationships between cancer survival and socio-economic factors for 11 major cancers.

2. Patients and methods

Incidence and follow-up data, used for computing survival rates, were obtained from EUROCARE 3, the largest study ever carried out to investigate cancer survival in Europe [12]. For our study, only elderly patients, those aged from 65 to 84 years, were considered. This choice of age range was intended to help overcome some of the well known problems with statistics in the very elderly, which are often not reliable due to the lower completeness and poorer quality of collection and registration [5,13].

The incidence data for cancers of the stomach, colon, rectum, lung, melanoma, breast, cervix and corpus uteri, ovary and prostate, and non-Hodgkin's lymphoma (NHL) related to 657,541 elderly subjects diagnosed during the period 1990–1994. Patients were followed up for at least five years in order to assess their vital status. Those patients recorded by the cancer registries (CRs) only through information from a death certificate (DCO cases) were excluded from the survival analysis. Information from death certificates mentioning cancer is used by CRs as a basis for "tracing back" (in time) and ascertaining cases previously not registered. Such cases tend to have shorter survival than average (because they died from cancer rather than an "other" cause). Death certificate information was not routinely available to the registries in France, The Netherlands and Sweden. This should be recognised as a potential cause of bias, affecting particularly the oldest age groups and should be taken into account when comparing survival rates for these three countries with those of other countries. Data were collected by 53 CRs in 19 European countries (Denmark, Finland, Iceland, Norway and Sweden in Northern Europe; United Kingdom; Austria, France, Germany, Switzerland and The Netherlands in Western Europe; Italy, Portugal and Spain in Southern Europe; Czech Republic, Estonia, Poland, Slovakia and Slovenia in Eastern Europe). Survival rates for the United Kingdom were calculated from the pooled data for England, Scotland and Wales. Table 1a, for men, and Tables 1b, 1c for women, show the numbers of cases and the relative survival at five years from diagnosis by country.

Observed and relative survival were computed using Hakulinen's methods [14]. Survival for each European country was taken to be the value for the national CR where one existed, otherwise the figure for the pool of participating CRs in that country was used.

The second part of the material comprises socio-economic variables and characteristics of the national health care systems. A representative for each participating country provided data at the ecological level, relating to the whole nation, through collection of information from national statistics offices and other official national or international sources.

In this way, we covered several aspects of the socio-economic field with a wide array of variables; only a few of these factors were chosen for inclusion in the current analysis. The selection procedures, and the whole database, were

Table 1a – Relative survival (%) at 5 years from diagnosis for men aged 65–84 years diagnosed during the period 1990–1994, by cancer site and country (countries ordered by decreasing rank of total health expenditure per capita in US$ Purchasing Parity Power)

Men	Stomach		Colon		Rectum		Lung		Melanoma		Prostate		NHL[a]	
	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases
Switzerland	22	116	55	286	58	170	8	469	82	84	71	856	51	95
Germany	28	415	54	779	51	450	10	1291	80	86	82	1599	50	149
France[b]	20	444	55	1005	48	644	14	1227	78	84	78	2118	46	253
Denmark	10	984	44	2548	42	2067	6	5633	70	504	44	5043	40	723
Norway	18	1431	52	2353	51	1608	7	3443	72	651	63	7679	37	694
The Netherlands[b]	16	872	50	1339	53	737	10	4432	79	159	70	3709	38	423
Austria	24	310	50	254	40	132	10	422	76	67	84	1009	56	49
Iceland	25	94	40	70	54	24	8	153	70	11	78	363	50	27
Sweden[b]	17	2477	52	4129	53	2889	7	4750	81	1307	70	19,071	44	1574
Italy	22	5036	51	5245	45	2765	9	13,188	59	516	67	8069	45	1688
Finland	19	1272	54	1045	50	996	7	4490	77	341	70	5766	36	617
United Kingdom	11	15,134	45	20,736	43	14,431	6	59,023	69	2266	54	47,155	37	6390
Spain	24	1509	55	1769	49	1162	12	4590	68	163	66	2812	50	417
Portugal	18	408	45	228	44	185	–	–	58	24	48	263	39	73
Slovenia	13	666	35	468	30	479	7	1358	57	88	50	864	46	133
Czeck Republic	13	248	37	365	26	343	4	913	55	61	54	537	35	76
Slovakia	19	1635	38	1329	25	1387	6	3596	41	187	50	2157	32	240
Poland	9	736	25	605	27	460	6	2218	50	65	42	852	23	183
Estonia	15	579	35	303	31	228	6	1178	62	38	52	748	31	59

RS%, relative survival (%).
a Non-Hodgkin's lymphoma.
b Information from death certificates not available to the cancer registries (see text).

Table 1b – Relative survival (%) at 5 years from diagnosis for women aged 65–84 years diagnosed during the period 1990–1994, by cancer site and country (countries ordered by decreasing rank of total health expenditure per capita in US$ Purchasing Parity Power)

Women	Stomach		Colon		Rectum		Lung		Melanoma		NHL[a]	
	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases
Switzerland	30	91	57	305	60	163	13	201	84	65	44	83
Germany	29	430	56	986	54	500	9	306	92	122	52	167
France[b]	25	296	55	870	59	494	16	182	79	122	43	280
Denmark	13	601	47	3096	44	1486	5	2728	83	655	45	751
Norway	20	880	53	2675	55	1243	9	1230	86	713	48	672
The Netherlands[b]	24	553	52	1607	53	683	10	827	88	230	43	467
Austria	39	242	59	310	45	154	16	155	83	84	42	69
Iceland	22	45	51	72	49	28	9	107	100	13	52	16
Sweden[b]	19	1397	55	4420	55	2238	10	2027	86	1115	48	1382
Italy	27	3510	51	5167	46	2199	8	2767	75	600	44	1842
Finland	23	1064	50	1585	48	941	9	1056	78	381	41	850
United Kingdom	13	8706	45	22,190	45	10,529	6	27,824	80	3417	40	6331
Spain	30	920	54	1425	52	746	10	396	88	210	49	469
Portugal	24	225	42	213	40	140	–	–	59	36	38	70
Slovenia	16	498	40	503	31	488	8	347	59	102	38	178
Czeck Republic	15	226	38	373	36	229	7	156	77	80	42	85
Slovakia	16	1023	42	1193	30	1031	10	576	57	208	34	232
Poland	10	453	27	662	28	424	6	1004	49	104	29	202
Estonia	19	609	36	519	23	321	11	311	51	79	35	68

RS%, relative survival (%).
a Non-Hodgkin's Lymphoma.
b Information from death certificates not available to the cancer registries (see text).

described in a previous paper [11]. However, only a summary of the variables we used is given here.

The indicators were divided into four groups: a group with macro-economic factors (values in US dollars at Purchasing Power Parity -US$ PPP-), including gross domestic product (GDP) and total health expenditure (THE); a group including the percentages of labour force employed in agriculture, industry and services; a group with the characteristics of

Table 1c – Relative survival (%) at 5 years from diagnosis for women aged 65–84 years diagnosed during the period 1990–94, by cancer site and country (countries ordered by decreasing rank of total health expenditure per capita in US$ Purchasing Parity Power)

Women	Breast		Cervix uteri		Corpus uteri		Ovary	
	RS%	Cases	RS%	Cases	RS%	Cases	RS%	Cases
Switzerland	78	768	48	44	70	168	16	139
Germany	78	1654	55	136	79	538	32	284
France[a]	78	2178	55	172	66	416	26	295
Denmark	72	5588	48	676	77	1646	24	1196
Norway	76	3948	52	432	71	976	27	975
The Netherlands[a]	77	3588	50	202	71	634	23	559
Austria	75	672	50	73	81	185	33	145
Iceland	78	142	53	14	61	33	42	37
Sweden[a]	82	10,086	49	699	76	2656	31	1895
Italy	79	10,349	49	787	70	2168	24	1536
Finland	78	4008	44	271	77	1238	24	885
United Kingdom	68	43,142	41	3525	66	7114	21	9070
Spain	76	3403	58	259	69	812	32	416
Portugal	74	441	38	68	–	–	39	71
Slovenia	65	1182	40	166	69	443	23	243
Czeck Republic	64	597	50	86	66	272	19	156
Slovakia	58	2046	36	440	55	1020	26	474
Poland	61	1453	39	364	60	482	22	405
Estonia	61	714	48	258	55	319	15	294

RS%, relative survival (%).
a Information from death certificates not available to the cancer registries (see text).

the national health care systems, including health employment (total health employment (TE), and total number of practitioners (TP), both per 1000 population), and medical technologies (computed tomography scanners (CTS), and equipment for nuclear magnetic resonance (ENMR), all per 1,000,000 population); and a group describing demographic factors, including marital status (proportion of population aged 65 years and older who were married and widowed) and household composition (the percentage of households with 1, 2, or 3 or more persons). The demographic indicators were taken from 1991 censuses, while all other factors related to period from 1993 to 1995.

Relative survival was correlated with socio-economic factors at the national level using Pearson's correlation (r) [15].

3. Results

3.1. *Correlation between relative survival, and macro-economic factors and medical resources*

Table 2 gives the correlations between cancer survival at 5 years from diagnosis for patients aged from 65 to 84 years, by cancer site and sex; the variables of the macro-economic group (GDP and THE); the percentage of labour force employed in agriculture (AGR); and medical resources (CTS and ENMR, TE and TP). The correlations for GDP and THE were highly positive for nearly all the cancer sites. Most, including those for cancers of the colon, rectum, melanoma, breast, uterus, prostate and NHL were close to or above 0.70, whereas those for stomach were lower, around 0.50–0.55. The correlations for lung and ovary were much lower. There were no marked differences by sex in the correlations with GDP and THE. All the correlations between cancer survival and the percentage of labour force employed in agriculture were negative; the coefficients were mostly around −0.60 or less, but there was little or no correlation for stomach, lung, cervix uteri and ovary. For CTS and ENMR very high, positive and statistically significant correlations (from around 0.5 to 0.8) were observed for most of the cancer sites, the exceptions being lung and ovary. Unlike CTS and ENMR, the levels of equipment for radiotherapy did not show any relationship with cancer survival (data not shown). The correlations for TE were lower than for CTS and ENMR: those for four of the cancers, colon (in women), rectum, melanoma and breast, were statistically significant at around 0.5–0.65. There was no association between TP and survival for any of the 11 cancers.

3.2. *Correlation between relative survival and demographic factors*

Table 3 gives the correlations between the proportions of married people and cancer survival in the total population, and between the proportions of the population by marital status and cancer survival in the elderly. Almost all of the correlations between the proportion of married people in the total population and cancer survival were small and numerically negative, and none was statistically significant. The survival of elderly women was generally more strongly related to marital status than that for men. There were statistically significant correlations between the proportion of elderly married people and survival of around 0.5–0.8 for cancers of the colon, rectum, melanoma, breast and cervix in women, and for stomach and lung in men. Apart from

Table 2 – Correlation (r) between macro-economic factors, labour force employed in agriculture, and health care resources with relative survival at 5 years from diagnosis in patients aged 65–84 years diagnosed during the period 1990–1994, by sex and cancer site

	Macro-economic factors				Labour force		Health care resources							
	GDP		THE		AGR		CTS		ENMR		TE		TP	
	W	M	W	M	W	M	W	M	W	M	W	M	W	M
Stomach	0.50°	0.51°	0.54°	0.57°	−0.38	−0.36	0.69*	0.73*	0.52°	0.53°	0.10	0.21	0.26	0.28
Colon	0.87*	0.78*	0.86*	0.78*	−0.78*	−0.74*	0.79*	0.58*	0.73*	0.59*	0.48°	0.47	0.18	0.23
Rectum	0.90*	0.83*	0.90*	0.83*	−0.69*	−0.63*	0.68*	0.69*	0.71*	0.73*	0.66*	0.64*	0.11	0.13
Lung	0.24	0.42	0.32	0.48°	−0.15	−0.28	0.43	0.37	0.34	0.18	0.15	0.01	0.07	0.09
Melanoma	0.82*	0.80*	0.79*	0.83*	−0.68*	−0.73*	0.76*	0.68*	0.67*	0.72*	0.51°	0.60*	0.03	−0.08
Breast	0.83*		0.82*		−0.63*		0.74*		0.67*		0.51°		0.29	
Cervix uteri	0.53°		0.57°		−0.44		0.52°		0.44		0.22		0.22	
Corpus uteri	0.70*		0.68*		−0.69*		0.55°		0.53°		0.20		0.02	
Ovary	0.25		0.22		−0.10		0.41		0.21		0.11		−0.04	
Prostate		0.66*		0.70*		−0.52°		0.84*		0.63*		0.43		0.16
NHL[a]	0.67*	0.65*	0.63*	0.68*	−0.58*	−0.55°	0.81*	0.70*	0.66*	0.51°	0.11	0.19	0.06	0.13

r Values are Pearson's correlation coefficients with an indication of their statistical significance (°P < 0.05, *P < 0.01). GDP, gross domestic product (per capita, US$ Purchasing Power Parity). THE, total health expenditure (per capita, US$ Purchasing Power Parity). AGR, labour force employed in agriculture per 100. CTS, number of computed tomography scanners per 1,000,000 population. ENMR, number of equipments for nuclear magnetic resonance per 1,000,000 population. TE, number of total health employment per 1000 population. TP, number of total practitioners per 1000 population. W, women, M, men. All data refer to the period 1993–1995.
a Non-Hodgkin's lymphoma.

NHL, all the correlations between the proportion of elderly widowed people were negative, but only those for rectum, melanoma and breast in women were statistically significant. The correlations between the proportions of never married elderly people and cancer survival were moderate, mostly in the range 0.25–0.5 and not statistically significant; the exceptions were for breast cancer, and rectal cancer in men.

In Table 4 the correlations between the proportions of the population by household composition and cancer survival in the elderly are given. There was generally no relationship for the proportion of one person households, the exception being for melanoma in men. The correlations for the proportion of households composed of two people were generally positive, those for colon, rectum and melanoma in both sexes, and breast and corpus uteri were in the range 0.5–0.75 and statistically significant. The correlations for the proportion of households with three or more people generally exhibited a weaker and inverse pattern to that for the proportion of two person households.

3.3. *Correlation between relative survival and THE, CTS*

Fig. 1 illustrates the correlation of relative survival by country for stomach and colon cancers (both sexes combined), breast and prostate cancers with THE; and Fig. 2 the correlation with

Table 3 – Correlation (r) between marital status (proportion in country) and relative survival at 5 years from diagnosis in patients aged 65–84 years diagnosed during the period 1990–1994, by sex and cancer site

	Total population		Elderly 65–84 years					
	Married		Married		Widowed		Never married	
	W	M	W	M	W	M	W	M
Stomach	−0.01	−0.11	0.18	0.50°	−0.20	−0.23	0.46	0.34
Colon	−0.25	−0.07	0.57°	0.34	−0.42	−0.38	0.39	0.29
Rectum	−0.20	−0.37	0.79*	0.11	−0.55°	−0.48	0.38	0.59°
Lung	−0.14	0.03	0.11	0.71°	0.25	−0.25	0.27	0.27
Melanoma	−0.39	−0.28	0.61°	−0.06	−0.73*	−0.44	0.38	0.39
Breast	−0.37		0.66*		−0.57°		0.52°	
Cervix uteri	0.27		0.49°		−0.31		0.42	
Corpus uteri	−0.16		0.22		−0.31		0.23	
Ovary	−0.47		0.30		−0.34		0.23	
Prostate		−0.21		0.41		−0.32		0.45
NHL[a]	−0.30	−0.15	0.22	0.34	0.34	0.35	0.33	0.42

r Values are Pearson's correlation coefficients with an indication of their statistical significance (°P < 0.05, *P < 0.01). W, women; M, men. All demographic data are from 1991 censuses.
a Non-Hodgkin's Lymphoma.

Table 4 – Correlation (r) between household composition (proportion in country) and relative survival at 5 years from diagnosis in patients aged 65–84 years diagnosed during the period 1990–1994, by sex and cancer site

	% 1 Person[a]		% 2 Persons[a]		% ⩾3 Persons[a]	
	W	M	W	M	W	M
Stomach	0.11	0.11	0.12	0.12	−0.01	0.02
Colon	0.35	0.31	0.56°	0.56°	−0.40	−0.37
Rectum	0.30	0.43	0.67*	0.69*	−0.47	−0.55°
Lung	0.20	−0.15	0.01	−0.09	−0.12	0.10
Melanoma	0.35	0.64°	0.72*	0.75*	−0.50	−0.67*
Breast	0.36		0.54°		−0.39	
Cervix uteri	0.20		0.28		−0.15	
Corpus uteri	0.40		0.53°		−0.40	
Ovary	−0.08		0.04		−0.02	
Prostate		0.33		0.39		0.27
NHL[b]	0.26	0.05	0.34	0.22	0.21	0.03

r Values are Pearson's correlation coefficients with an indication of their statistical significance (°$P < 0.05$, *$P < 0.01$). All demographic data are from 1991 censuses.

a % of households with 1 person, 2 persons, 3 or more persons on total number of households. W, women; M, men.

b Non-Hodgkin's lymphoma.

the number of CTS. THE and CTS were chosen because they were variables which were generally highly related to survival and describe important aspects of the health care systems. We have included stomach, colon, breast and prostate cancers because of their high incidence in the elderly population and their positive relationships with the socio-economic indicators.

Survival for stomach was generally low, with similar values in both poor and more affluent countries; the UK and Denmark, despite their higher values of THE, had similar survival to the Eastern European countries. For colon and breast cancers the correlation with THE was stronger, but over about US$ 1600 there were only small differences in survival among the countries. There was much wider variability in survival for prostate cancer, which increased with THE up to around 80% in France and Germany, which had the highest THE values (around US$ 2000) except for Switzerland; Denmark had by far the lowest survival among Western and Northern European countries.

The number of CTS (per million population) was highly correlated with survival for all four cancer sites. For stomach and prostate cancers, the charts show a clear linear relationship, with survival rates increasing progressively from the countries with fewer than 5 CTS up to those with the highest number (around 20). For colon and breast cancers, survival generally increased only up to around 10 CTS.

4. Discussion

4.1. *Cancer survival, macro-economic factors and medical resources*

The affluence of a country, represented by GDP and THE, was very strongly related to survival in the elderly for most of the 11 major cancer sites we studied. The correlation was strong for cancers with a reasonably good prognosis in the elderly; but for cancers of the stomach and cervix uteri the association was much less strong, and no association was observed for cancers of the lung and ovary which have quite poor survival. It appears that the affluence of even the most developed European countries has little effect on survival for lung and ovary cancers, for which clinical treatment is generally not very effective. Clinical management through major surgery or complex chemotherapeutic regimens is often difficult to apply in elderly patients, who are often suffering from a heterogeneous group of co-morbid conditions and have physiological impairment [16]. For stomach and cervix uteri cancers the situation is more complex. The partial lack of correlation for stomach is due to the variation in case mix, among the European countries: the Northern countries and the UK have a subsite distribution different from the Southern countries, with a higher percentage of proximal locations (cardia and fundus) which have a poorer prognosis [17]. If we exclude these countries from the analysis, the correlation between stomach cancer survival and the independent variables would be more marked. Indeed, the low survival in affluent countries, such as the UK, The Netherlands and Scandinavian countries, is consistent with the association between high socio-economic status and tumour characteristics with adverse prognostic factors, such as advanced stage at diagnosis, cardia subsite and diffuse histology type [18,19]. Elderly women have a high rate of under- or non-use of cervical screening and are likely to be lifelong under-utilisers, probably with a higher incidence of cervical cancer than screened women [20]. Cervical cancer has reasonably good prognosis in young women but survival quickly decreases with age. The relative risks for older women versus the middle aged of dying from cervical cancer were among the highest of all cancers, 1.8 and 1.3 at 1 and 5 years from diagnosis, respectively, with the largest disadvantage in the most elderly patients [4]. In most of the population-based studies examining early diagnosis and disease extension, cervix uteri presented more often than other cancers at an advanced stage in elderly patients. Treatment in elderly women is often less aggressive than in younger women – and the elderly are more likely to receive no treatment at all [21,22]. Thus not only is invasive cervical cancer more common at older ages, but the survival of elderly women is worse [23].

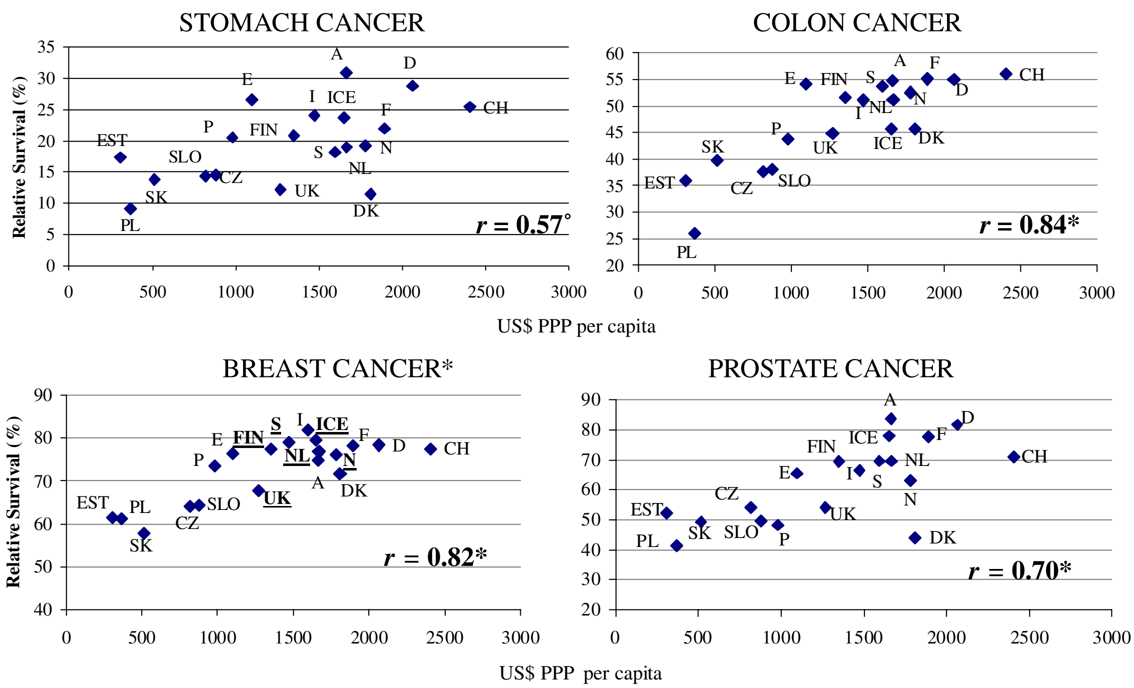

Fig. 1 – Correlation (*r*) between relative survival (%) at 5 years from diagnosis in patients diagnosed during the period 1990–1994, and total health expenditure (per capita, US$ Purchasing Parity Power), in patients aged 65–84 years (both sexes combined for stomach and colon cancers). *r* Values are Pearson's correlation coefficients with an indication of their statistical significance (°P < 0.05, *P < 0.01). PPP, Purchasing Power Parity. *, countries in bold type and underlined: organised mass screening in place during the incidence period (1990–1994). A, Austria; CZ, Czech Republic; DK, Denmark; EST, Estonia; FIN, Finland; F, France; D, Germany; ICE, Iceland; I, Italy; NL, Netherlands; N, Norway; PL, Poland; P, Portugal; SK, Slovakia; SLO, Slovenia; E, Spain; S, Sweden; CH, Switzerland; UK, United Kingdom.

CTS showed the strongest correlations with survival: the coefficients were similar to those for GDP and THE, and just a little higher than those for ENMR. As for the health personnel indicators, TE correlated quite well with survival, whereas TP did not. Our results are consistent with other analyses that showed, in Western countries, that GDP had a closer relationship with the number of nurses than with the number of general practitioners [24]. In some countries, such as Spain and Italy, the number of physicians (per head of population) is much higher than elsewhere, and there is an imbalance in the ratio of graduate and non-graduate staff, which is not in accordance with the recommendations of the World Bank [25].

4.2. *Cancer survival and demographic factors*

Marital status played a very important role: for several cancer sites including colon, rectum and breast which have high incidence, survival was related positively with the proportion of married elderly women in the population and negatively with the proportion of widows. Marital status did not however, have the same relevance for women for all ages combined. There was a marked difference between the sexes: survival for elderly men generally did not appear to be influenced by these types of demographic factors. Demographic factors could play a major role in determining health outcomes in elderly women, by affecting access to health care and delay in diagnosis.

These results confirm our previous comparisons between cancer survival in elderly and middle aged adults. Cancer patients aged over 65 years experienced much higher risks of dying than younger adults, particularly at 1 year from diagnosis and for those cancers for which disease stage was the main prognostic determinant. Furthermore, the disadvantage of elderly women was larger than that of elderly men [4].

Being married or widowed is for elderly people, in particular elderly women, an important factor influencing psychological status, life habits, social relationships and the use of support services offered by the community [26]. Elderly women are more likely to have a lower degree of social independence on account of, for example, having lower income and educational levels than elderly men, and to lack easy access to transport. Furthermore, they have often outlived their husbands, often have disabilities, and often need home care [27]. Large population-based studies have shown that insufficient social support is a risk factor for lower cancer survival [28].

In the elderly, survival for several of the major cancers was related to the proportion of two person households. Two people living together would be able to provide reciprocal social support, whereas families with three or more members could be associated with relatively low affluence, and many more problems of social dependence.

One might have expected strong negative correlations between cancer survival and the percentage of families with one person, but we found generally only weak positive relationships. Unfortunately, with the available data we could not

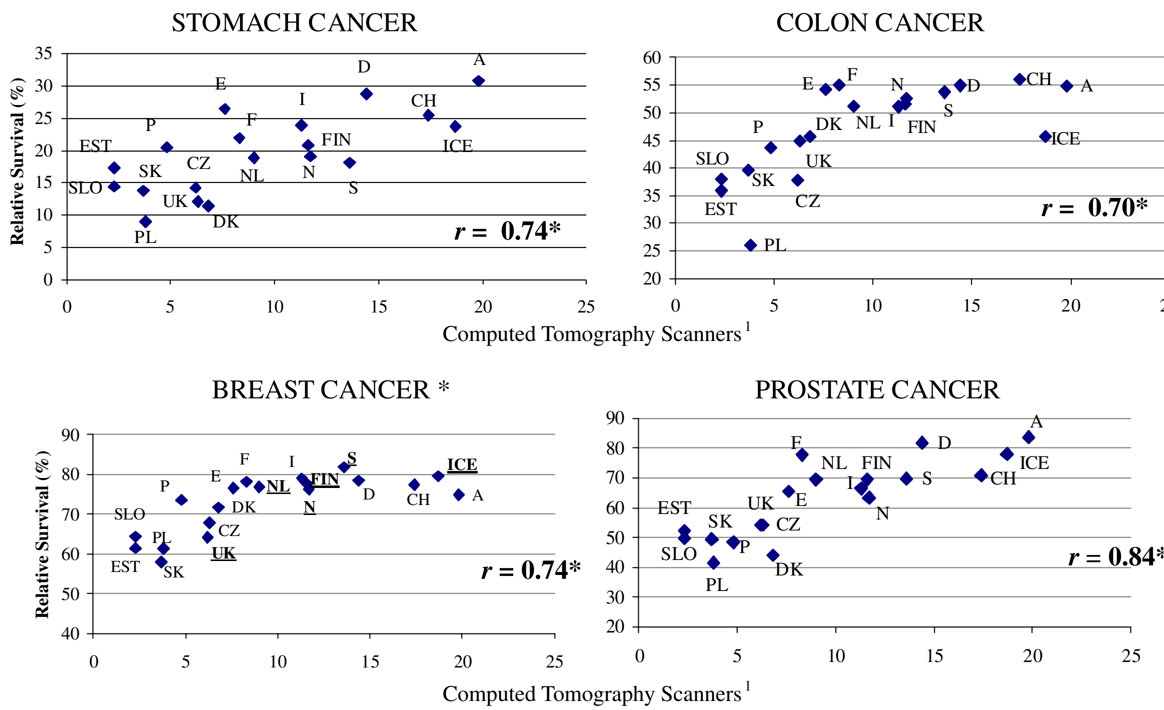

Fig. 2 – Correlation (*r*) between relative survival (%) at 5 years from diagnosis in patients diagnosed during the period 1990–1994, and computed tomography scanners (per 1,000,000 population), in patients aged 65–84 years (both sexes combined for stomach and colon cancers). *r* Values are Pearson's correlation coefficients with an indication of their statistical significance (°P < 0.05, *P < 0.01). [1]Equipment per 1,000,000 population. *, Countries in bold type and underlined: organised mass screening in place during the incidence period (1990–1994). A, Austria; CZ, Czech Republic; DK, Denmark; EST, Estonia; FIN, Finland; F, France; D, Germany; ICE, Iceland; I, Italy; NL, Netherlands; N, Norway; PL, Poland; P, Portugal; SK, Slovakia; SLO, Slovenia; E, Spain; S, Sweden; CH, Switzerland; UK, United Kingdom.

examine household composition by age, and households with only one person would include a large number of young people living alone.

5. Conclusions

In the elderly, the correlation between GDP and survival was strong for most cancer sites. However, the countries with the highest THE did not always have the highest survival rates (particularly for breast and prostate cancers) and over a level of expenditure of around US$ 1600, survival did not improve further. Some authors have claimed that increases in THE above a fairly high threshold does not always correspond with further improvement in health performance [29–32].

All European countries have been trying to provide their populations with equal access to health care, but remarkable differences still exist [33]. Countries with similar total GDP obtain better health outcomes when the distribution of income is more egalitarian [34].

A particular role is played by factors related indirectly to social support. These observations could have remarkable consequences for health spending, because the number of elderly people is rising and they use health care services at a higher rate than young people [27]. A social network to help elderly people to cope with cancer and its therapies is becoming increasingly important, especially now that the number of elderly people living alone is also rising [34]. Suitable choices of social policy and specific health care plans should therefore be high priority in order to maintain both good health and quality of life in elderly people.

Conflict of interest statement

All the Authors declare that any financial and personal relationships with other people or organisations have inappropriately influenced their work.

Acknowledgements

The project was financed through "Europe against cancer" programme of European Union.

We are grateful to the EUROCARE Steering Committee and Working Group and to Danish Cancer Registry which provided data for Denmark.

We also thank the members of EUROCHIP-II project very much for their co-operation; this programme was subsidised by the European Commission, Public Health Programme, 2004.

REFERENCES

1. Berrino F, Sant M, Verdecchia A, et al. *Survival of cancer patients in Europe: the EUROCARE study*. Lyon, IARC Scientific Publications No. 132; 1995.

2. Berrino F, Capocaccia R, Esteve J, et al. *Survival of cancer patients in Europe: the EUROCARE-2 study*. Lyon, IARC Scientific Publications No. 151; 1999.
3. Sant M, The EUROCARE Working Group. Overview of EUROCARE-2 results on survival of cancer patients diagnosed in 1985–89. In: Berrino F, Capocaccia R, Esteve J, et al., editors. *Survival of cancer patients in Europe: the EUROCARE-2 study*. Lyon, IARC Scientifica Publication No. 151; 1999. p. 525–42.
4. Vercelli M, Quaglia A, Casella C, et alThe EUROCARE Working Group. Relative survival in elderly cancer patients in Europe. *Eur J Cancer* 1999;**34**:2264–70.
5. Vercelli M, Capocaccia R, Quaglia A, et alThe EUROCARE Working Group. Relative survival in elderly European cancer patients: evidence for health care inequalities. *Crit Rev Oncol Hematol* 2000;**35**:161–79.
6. Monfardini S, Yancik R. Cancer in the elderly: meeting the challenge of an aging population. *J Natl Cancer Inst* 1993;**85**:532–8.
7. Kaplan G, Seeman T, Cohen R, et al. Mortality among the elderly in the Alameda County Study: behavioural and demographic risk factors. *Am J Public Health* 1987;**77**:307–12.
8. Kaplan G, Haan M. Is there a role for prevention among the elderly? Epidemiological evidence from the Alameda county study. In: Ory MG, Bond K, editors. *Aging and health care: social science and policy perspectives*. London: Routledge; 1989. p. 27–51.
9. Kitagawa F, Houser P. *Differential mortality in the United States: a study in socio-economic epidemiology*. Cambridge: Harvard Univesity Press; 1973.
10. Salas C. On the empirical association between poor health and low socio-economic status at old age. *Health Econ* 2002;**11**:207–20.
11. Quaglia A, Vercelli M, Lillini R, et alThe ELDCARE Working Group. Socio-economic factors and health care system characteristics related to cancer survival in the elderly. A population-based analysis in sixteen European countries (ELDCARE project). *Crit Rev Oncol Hemat* 2005;**54**:117–28.
12. Berrino F, Capocaccia R, Coleman MP, et al. Survival of cancer patients in Europe: the EUROCARE-3 study. *Ann Oncol* 2003;**14**(5).
13. Bain MRS, Harvey JC, Muir CS. Epidemiology research in ageing: perspectives and limitations. In: Balducci L, Lyman GH, Ershler GH, editors. *Geriatric oncology*. Amsterdam: Harwood Academic Publication; 1998. p. 105–14.
14. Hakulinen T, Abeywickrama KH. A computer program package for relative survival analysis. *Comp Prog Biomed* 1985;**19**:197–207.
15. Bohrnstedt GW, Knoke D. *Statistica per le scienze sociali*. Bologna, Il Mulino; 1998.
16. Coebergh JW, Janssen-Heijnen ML, Post PN, et al. Serious co-morbidity among unselected cancer patients newly diagnosed in the southeastern part of The Netherlands in 1993–1996. *J Clin Epidemiol* 1999;**52**:1131–6.
17. Verdecchia A, Corazzieri I, Gatta G, et alThe EUROCARE Working Group. Explaining gastric cancer survival differences among European countries. *Int J Cancer* 2004;**109**:737–41.
18. Schrijvers CTM, Coebergh JWW, Mackenbach JP. Socioeconomic variation in cancer survival in the Southeastern Netherlands, 1980–1989. *Cancer* 1995;**75**:2946–53.
19. Pinheiro PS, Van der Heijden LH, Coebergh JWW. Unchanged survival of gastric cancer in the Southeastern Netherlands since 1982: result of differential trends in incidence according to Lauren type and subsite. *Int J Cancer* 1999;**84**:28–32.
20. Mandelblatt J, Gopaul I, Wistreich M. Gynaecological cancer of elderly women: another look at papanicolaou smear testing. *JAMA* 1986;**256**:367–71.
21. Chapman GW. Survival of advanced age females with cervical carcinoma. *Gyn Oncol* 1992;**46**:287–91.
22. Wright JD, Gibb RK, Geevarghese S, et al. Cervical carcinoma in the elderly. An analysis of patterns of care and outcome. *Cancer* 2005;**103**:85–91.
23. Dickman PW, Hakulinen T, Luostarinen T, et al. Survival of cancer patients in Finland 1955–1994. *Acta Oncol* 1999;**38**:1–103.
24. Poikolainen K, Eskola J. Health services resources and their relation to mortality from causes amenable to health care intervention: a cross-national study. *Int J Epidemiol* 1988;**17**:86–9.
25. The World Bank. *World Development Report 1993: investing in health*. New York: Oxford University Press; 1993.
26. Murphy M, Goldblatt P, Thornton-Jones H, et al. Survival among women with cancer of the uterine cervix: influence of marital status and social class. *J Epidemiol Comm Health* 1990;**44**:293–6.
27. Spillman BC, Lubitz J. The effect of longevity on spending for acute and long-term care. *New Engl J Med* 2000;**342**:1409–15.
28. Goodwin JS, Hunt C, Samet J. Relationship of marital status to stage at diagnosis, choice of treatment and survival in individuals with cancer. *JAMA* 1987;**258**:3125–30.
29. Baily MN, Garber AM. Health care productivity. In: Baily MN, Reiss PR, Winston C, editors. *Brooking papers on economic activity-micro economics*. Washington (DC): Brookings Institution; 1997. p. 143–215.
30. Schieber GJ, Poullier JP, Greenwald LM. Health spending, delivery, and outcomes in OECD countries. *Health Aff (Millwood)* 1993;**12**:120–9.
31. Blumenthal D. Controlling health care expenditures. *New Engl J Med* 2001;**344**:766–9.
32. Clemmitt M. U.S spends a lot on health but doesn't know what it buys. *Med Health* 2000;**54**(22).
33. Elola J, Da Ponte A, Navarro V. Health indicators and the organization of health care systems in Western Europe. *Am J Pub Health* 1995;**85**:1397–401.
34. Kovner CT, Mezey M, Harrington C. Who cares for older adults? Workforce implications of an aging society. *Health Aff (Millwood)* 2002;**21**:78–89.