Social inequality and incidence of and survival from cancer of the female genital organs in a population-based study in Denmark, 1994–2003

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ABSTRACT

We investigated the effects of socioeconomic, demographic and health-related indicators on the incidence of and survival from cancers of the cervix, endometrium and ovary diagnosed in 1994–2003 with follow-up through 2006 in Denmark using information from nationwide registers. The analyses were based on the data on 3007 patients with cervical cancer, 3826 with endometrial cancer and 3855 with ovarian cancer in a cohort of 3.22 million persons born between 1925 and 1973 and aged ⩾30 years. The incidence of cervical cancer increased with decreasing socioeconomic position; the incidences of endometrial and ovarian cancer were mostly associated with higher disposable income. Relative survival from cervical cancer was the highest among women of high socioeconomic position; increased excess mortality rates from endometrial and ovarian cancer were associated with low educational level, mainly during the first year after diagnosis. Socioeconomic position seemed to affect both the incidence of and the survival from cancers of the female genital organs.

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1. Introduction

In Denmark, the incidence of and mortality from cervical cancer have decreased since the 1960s, those of endometrial cancer since the early 1980s and those of ovarian cancer since the early 1970s.[1–3] Altogether, one of these cancers was diagnosed in nearly 1600 Danish women in 2003, and in 2001 more than 700 died.[3] Endometrial cancer is the commonest of the three cancers of the female genital organs, with, in 2003, 633 cases, as compared with 549 cases of ovarian cancer and 408 of cervical cancer. Ovarian cancer is the most lethal gynaecological cancer, accounting for 447 deaths, whereas cervical cancer

caused 148 deaths and endometrial cancer caused 123 deaths in 2001.[3]

A meta-analysis of social inequality in cervical cancer showed an odds ratio of 1.97 (95% CI, 1.80–2.15) for cervical cancer among women of low socioeconomic position when compared with women of high socioeconomic position.[4] This social disparity is often explained by differences in sexual habits, infection with human papillomavirus (HPV)[5] and compliance with screening.[6] Survival from cervical cancer is also the poorest mainly in groups of low socioeconomic position.[7] Relatively few studies have addressed associations between socioeconomic position and the risks for endometrial and

ovarian cancer, and the results have been inconsistent;[8,9] however, mortality from these two cancers has been found relatively consistently to be the highest in women of low socioeconomic position.[7]

The aim of this register-based study was to assess whether socioeconomic position plays a role in the incidence of and survival from cervical cancer, ovarian cancer and endometrial cancer in Denmark, as part of a comprehensive, rigorous analysis of the role of socioeconomic status in cancer incidence and survival.

2. Materials and methods

The material and methods are described elsewhere.[10] Briefly, the study population comprised all 3.22 Danish residents (1.59 million women) born between 1925 and 1973 without a previous incidence of cancer and who entered the cohort at age 30 (see Fig. 1 in [10]). Information on socioeconomic, demographic and health-related indicators was obtained from various Danish registers based on administrative data.[10] Crude, age-specific and age-standardised incidence rates are presented for cervical cancer (ICD-10 C53), endometrial cancer (ICD-10 C54) and ovarian cancer (ICD-10 C56, C57.0–4) diagnosed in the cohort in 1994–2003. The incidence rates were standardised by age (in 5-year age groups) and period (in two 5-year periods), with the total study population as the standard.[11] Further, we used log-linear Poisson regression to model incidence rate ratios (IRRs), first adjusted for period (in 5-year periods) and age (as two continuous variables: age and age^2 in years) and secondly by adding education and disposable income to the models. For each level of each indicator, we conducted relative survival analyses, adjusting for population mortality among the incident cancer cases in 1994–2003 with follow-up through 2006.[10] Population mortality rates were stratified by age, period and the respective indicator. Except for the analyses of ethnicity, all analyses included only residents born in Denmark to at least one Danish-born parent with Danish citizenship.[10]

3. Results

3.1. Cervical cancer

The study population consisted of 3007 women born in 1924–1974 in whom cervical cancer was diagnosed during 1994–2003. These represented 70% of all cervical cancers in that period. Among Danish women, the age- and period-standardised incidence rate was 23 per 100,000 women-years.

3.2. Incidence of cervical cancer

The age- and period-standardised incidence rate for cervical cancer decreased with increasing education. The incidence rate difference between women with basic schooling and higher education was 8 per 100,000 person-years, and the incidence rate difference between those with vocational and higher education was 3 per 100,000 person-years (Fig. 1).

The IRRs for cervical cancer according to socioeconomic, demographic and health-related variables are shown in

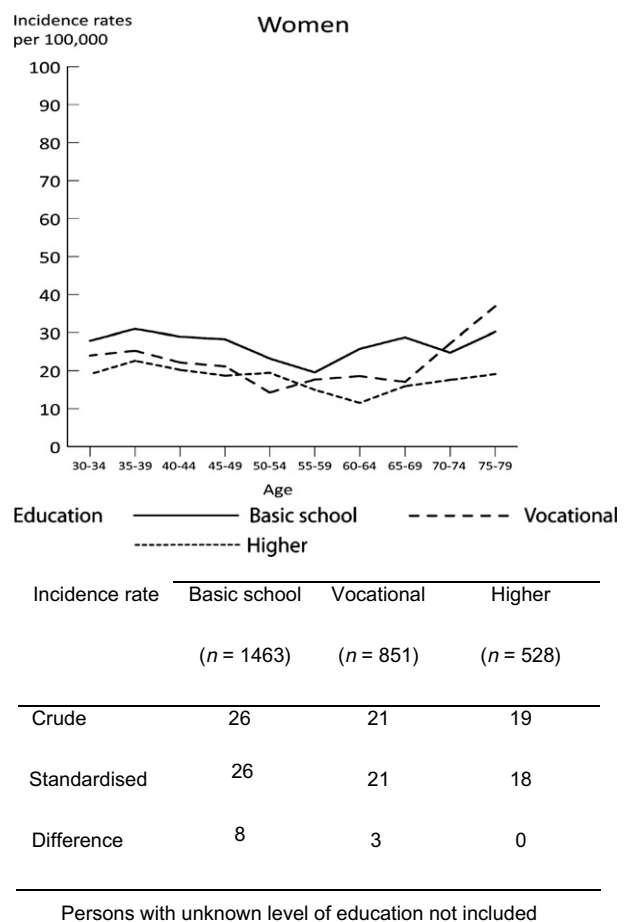| Incidence rate	Basic school (n = 1463)	Vocational (n = 851)	Higher (n = 528)
Crude	26	21	19
Standardised	26	21	18
Difference	8	3	0

Persons with unknown level of education not included

Fig. 1 – Age-specific incidence rates per 100,000 person-years for cervical cancer by education among persons born in 1925–1973, Denmark, 1994–2003. Supplementary table shows the crude incidence rate and the incidence rate standardised by age (5-year age groups) and period (two 5-year periods) with the total study population as the standard and the incidence rate difference with higher education as the reference.

Table 1. The IRRs, adjusted for age, period, education and income, increased with decreasing level of education, disposable income, affiliation to the work market, housing tenure and size of dwelling and decreased with decreasing urbanity. In comparison with married women, all other groups had higher IRRs for cervical cancer, the difference being most pronounced for divorced women. The social class variable showed no clear pattern in relation to cervical cancer; however, women in the agricultural class had a lower IRR of cervical cancer than women in the manual class. Based on small numbers immigrants and descendants from non-western countries had a lower IRR than Danish women, whereas a diagnosis of schizophrenia or other psychoses increased the IRR.

3.3. Relative survival from cervical cancer

For patients with cervical cancer diagnosed in 1994–2003, the 1-year relative survival was 89% and the 5-year relative survival was 71%.

Table 1 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for cervical cancer in Danish women born in 1925–1973 and aged ⩾30 years, by socioeconomic, demographic and health-related variables, Denmark, 1994–2003

	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)
Level of education			
Basic or high school	1463	1.00	1.00
Vocational education	851	0.78 (0.71–0.85)	0.80 (0.74–0.88)
Higher education	528	0.71 (0.64–0.78)	0.75 (0.68–0.84)
Unknown	33	0.94 (0.67–1.33)	0.94 (0.67–1.33)
Disposable income[c]			
Lowest (1st quartile)	815	1.17 (1.07–1.28)	1.13 (1.03–1.23)
Middle (2nd–3rd quartile)	1484	1.00	1.00
Highest (4th quartile)	576	0.78 (0.71–0.86)	0.82 (0.74–0.90)
Affiliation to work market[d]			
Working	1822	1.00	1.00
Unemployed or other	505	1.27 (1.15–1.41)	1.14 (1.03–1.27)
Early retirement pensioner	315	1.52 (1.34–1.73)	1.31 (1.15–1.50)
Social class[e]			
Creative core	65	0.74 (0.57–0.97)	0.97 (0.73–1.29)
Creative professional	218	0.70 (0.58–0.83)	0.85 (0.71–1.03)
Bohemian	10	0.93 (0.50–1.75)	1.14 (0.60–2.14)
Service	1721	0.86 (0.76–0.98)	0.95 (0.84–1.09)
Manual	282	1.00	1.00
Agricultural	29	0.60 (0.41–0.88)	0.60 (0.41–0.88)
Unknown	550	1.05 (0.91–1.21)	1.05 (0.90–1.21)
Housing tenure			
Owner-occupied	1590	1.00	1.00
Rental	1242	1.58 (1.46–1.70)	1.51 (1.40–1.63)
Unknown	43	1.32 (0.97–1.79)	1.27 (0.94–1.72)
Size of dwelling (m^2)			
0–49	75	1.63 (1.29–2.06)	1.55 (1.22–1.96)
50–99	1243	1.41 (1.30–1.53)	1.37 (1.26–1.49)
100–149	1022	1.00	1.00
⩾150	535	0.88 (0.79–0.97)	0.91 (0.82–1.01)
Cohabiting status			
Married	1516	1.00	1.00
Cohabiting	460	1.60 (1.44–1.79)	1.61 (1.44–1.80)
Single	279	1.23 (1.08–1.40)	1.18 (1.04–1.35)
Widow	196	1.44 (1.23–1.70)	1.38 (1.17–1.62)
Divorced	424	2.02 (1.81–2.25)	1.90 (1.70–2.12)
Type of district			
Capital area	962	1.00	1.00
Provincial city	1486	0.96 (0.89–1.04)	0.91 (0.84–0.99)
Rural area	305	0.87 (0.77–0.99)	0.81 (0.71–0.92)
Peripheral rural area[f]	122	0.82 (0.68–0.99)	0.75 (0.62–0.90)
Ethnicity[g]			
Danish	2875	1.00	1.00
Immigrant or descendant from western country	70	1.06 (0.83–1.34)	1.08 (0.85–1.37)
Immigrant or descendant from non-western country	62	0.61 (0.48–0.79)	0.55 (0.42–0.71)
Charlson comorbidity index[h]			
None	2611	1.00	1.00
1	167	1.03 (0.88–1.21)	0.99 (0.84–1.16)
⩾2	97	1.12 (0.91–1.37)	1.08 (0.88–1.32)
Depression			
No	2809	1.00	1.00
Yes	66	1.04 (0.81–1.33)	1.00 (0.78–1.27)
Schizophrenia or other psychoses			
No	2829	1.00	1.00
Yes	46	1.46 (1.09–1.95)	1.35 (1.01–1.80)

a Adjusted for calendar period (in 5-year intervals) and age modelled as age and age^2 in years.
b Adjusted for calendar period and age (as above) and additionally for level of education and disposable income.

Table 1 – *continued*

c Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.

d For pensioners, work market affiliation before pension date was assigned and followed up to age 69.

e Based on theory of creative class:[18] the creative core (e.g. researchers, designers, architects), creative professionals (e.g. managers, business and finance, lawyers, doctors), bohemians (e.g. artists, models), the service class (e.g. nurses, hairdressers, caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers, fishermen).

f More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.

g Included as a separate indicator, but ethnic groups were excluded from the study population in all other analyses presented in Table 1, e.g. education and income.

h The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[10] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.
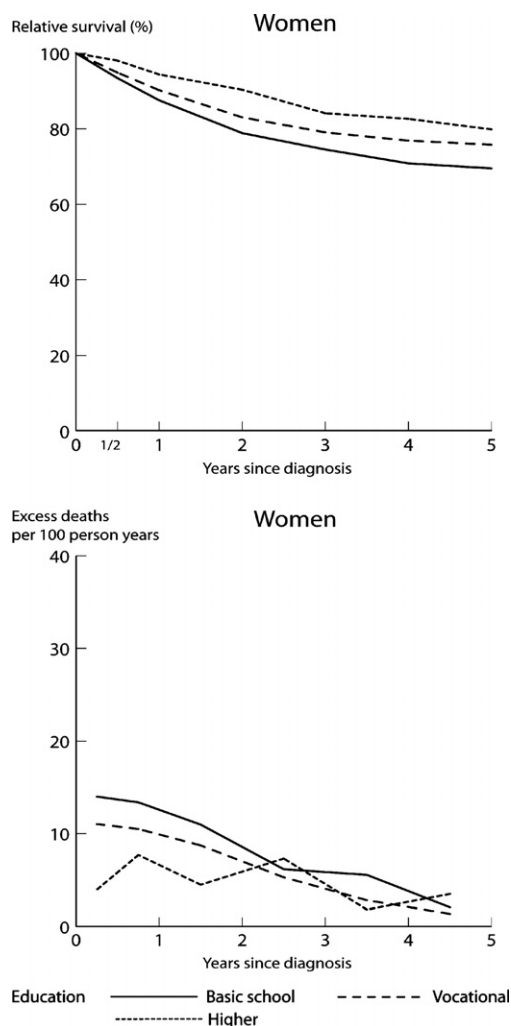

Fig. 2 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born in 1925–1973, with cervical cancer diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients and the survival that would have been expected if the patients had had the same age-, period- and education-specific mortality as the total study population. Excess mortality is excess to the same population mortality and estimated in intervals since diagnosis. Estimates were standardised for age on the basis of the age distribution of all patients with cervical cancer in the study cohort.

Fig. 2 shows age-standardised relative survival and excess mortality curves by education. Women with higher education had better relative survival than women with basic schooling or vocational education, independently of time since diagnosis. After 1–2 years, a difference was also found between women with basic schooling and vocational education, the former having the lowest survival. The curves for excess mortality rate show a marked difference between educational groups, women with basic schooling having the highest excess mortality rate up to 2 years after diagnosis, whereafter the differences among educational groups appeared to level out.

The 1- and 5-year relative survival by socioeconomic, demographic and health-related variables in cervical cancer patients is shown in Table 2. In general, both short- and longer-term relative survival increased with increasing education, disposable income, affiliation to the work market, housing tenure and size of dwelling. No clear pattern was observed in relation to social class, although the creative classes tended to have better relative survival. Single and divorced women had poorer relative survival than cohabiting and married women; however, the confidence intervals overlapped. The 1- and 5-year relative survival tended to be reduced by the presence of any somatic or psychiatric disorder. Lastly, immigrants or descendants from non-western countries had better short- and longer-term relative survival than women of Danish origin. It should be noted, however, that the estimates for ethnicity and psychiatric disorders were based on small numbers.

3.4. Endometrial cancer

The study cohort consisted of 3826 Danish women in whom endometrial cancer was diagnosed in the period 1994–2003, representing 63% of the total number of cases of endometrial cancer in Denmark in that period. Among Danish women, the age- and period-standardised incidence rate was 29 per 100,000 women–years.

3.5. Incidence of endometrial cancer

After standardisation for age and period, no major difference was observed in the incidence rate of endometrial cancer in relation to educational level. The incidence rate difference between women with higher education and those with basic schooling was 2 per 100,000 person-years (Fig. 3). Table 3 presents the adjusted IRRs for socioeconomic, demographic and

Table 2 – 1-year and 5-year relative survival[a] (%) with 95% confidence interval (95% CI) by socioeconomic, demographic and health variables in patients aged ⩾30 years born in 1925–1973, with cervical cancer diagnosed in Denmark between 1994 and 2003 and followed through 2006

		Women			
	No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI
Level of education					
Basic or high school	1459	88	86–89	68	66–70
Vocational education	851	90	88–92	74	71–77
Higher education	528	94	92–97	78	73–83
Unknown	33	86	78–95	76	64–90
Disposable income[b]					
Lowest (1st quartile)	812	87	85–89	68	65–72
Middle (2nd–3rd quartile)	1483	89	87–91	71	69–74
Highest (4th quartile)	576	92	89–95	73	69–77
Affiliation to work market[c]					
Working	1822	94	93–95	79	77–81
Unemployed or other	503	89	87–92	75	71–79
Early retirement pensioner	313	78	71–85	55	47–64
Social class[d]					
Creative core	65	95	89–101	88	80–96
Creative professional	218	93	89–97	77	71–84
Bohemian	10	83	–	68	58–79
Service	1718	90	88–91	72	70–74
Manual	282	91	87–94	70	65–76
Agricultural	29	92	83–103	72	57–91
Unknown	549	85	82–88	65	60–69
Housing tenure					
Owner-occupied	1589	91	90–92	73	71–76
Rental	1240	87	86–89	68	66–71
Unknown	42	85	75–97	70	57–86
Size of dwelling (m²)					
0–49	74	69	61–79	56	47–68
50–99	1241	88	86–90	69	67–72
100–149	1021	91	90–93	74	71–76
⩾150	535	91	89–94	73	69–77
Cohabiting status					
Married	1515	91	89–92	72	70–74
Cohabiting	460	89	85–93	71	67–76
Single	278	81	74–89	62	54–71
Widow	195	83	72–95	73	61–86
Divorced	423	86	83–90	66	61–71
Type of district					
Capital area	960	90	88–91	71	68–74
Provincial city	1484	89	88–91	71	68–73
Rural area	305	89	85–92	72	67–78
Peripheral rural area[e]	122	87	81–93	68	61–77
Ethnicity[f]					
Danish	2871	89	88–90	71	69–73
Immigrant or descendant from western country	69	91	86–97	69	59–81
Immigrant or descendant from non-western country	62	97	93–102	88	80–97
Charlson comorbidity index[g]					
None	2607	90	89–91	72	70–74
1	167	84	78–90	63	55–72
⩾2	97	81	73–90	58	48–71
Depression					
No	2805	89	88–91	71	69–73
Yes	66	80	71–92	60	49–75

Table 2 – continued

		Women			
	No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI
Schizophrenia or other psychoses					
No	2825	90	89–91	71	70–73
Yes	46	66	53–82	46	34–61

a Ratio of observed survival of cancer patients and survival that would have been expected if the patients had had the same age-, period-, socioeconomic, demographic or health-related indicator-specific mortality as the total study population; for 'social class' and 'ethnicity', expected survival is adjusted only for age, not period, because of low power.

b Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.

c For pensioners, work market affiliation before pension date was assigned and followed up to age 69.

d Based on theory of creative class (18): the creative core (e.g. researchers, designers, architects), creative professionals (e.g. managers, business and finance, lawyers, doctors), bohemians (e.g. artists, models), the service class (e.g. nurses, hairdressers, caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers, fishermen).

e More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.

f Excluded from the study population in all other analyses presented in Table 2.

g The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[10] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.

Incidence rate	Basic school	Vocational	Higher
	(*n* = 2044)	(*n* = 1047)	(*n* = 565)
Crude	37	25	20
Standardised	29	29	31
Difference	0	0	2

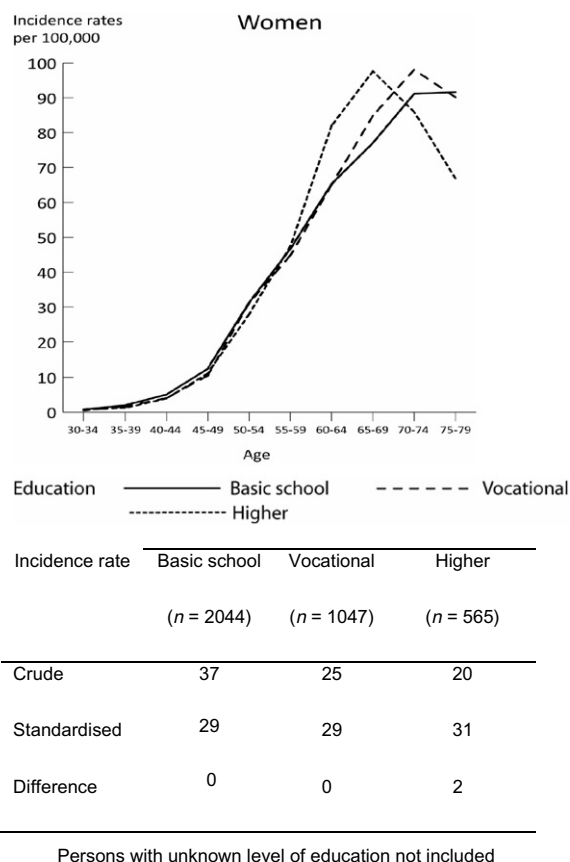Persons with unknown level of education not included

Fig. 3 – Age-specific incidence rates per 100,000 person-years for endometrial cancer by education among persons born in 1925–1973, Denmark, 1994–2003. Supplementary table shows the crude incidence rate and the incidence rate standardised by age (5-year age groups) and period (two 5-year periods) with the total study population as the standard and the incidence rate difference with basic school as the reference.

health-related variables. The incidence of endometrial cancer was significantly increased among women with high disposable income and those who were single compared to those being married, whereas women who were divorced had a lower IRR for endometrial cancer. A significantly decreased IRR was observed when comorbidity (depression and disorders in the Charlson comorbidity index) was present (Table 3).

3.6. Relative survival from endometrial cancer

For women diagnosed with endometrial cancer in the period 1994–2003, the 1-year relative survival was 94%, and the corresponding 5-year relative survival was 80%.

As illustrated in Fig. 4, no marked difference in relative survival was observed according to educational level, although relative survival was slightly lower in the group of women with basic school education during the entire observation period. The excess mortality curves show that women with basic schooling had high mortality during the first 1–2 years after diagnosis, whereafter the excess mortality rate was similar to that of women with higher education.

In general, no strong association between socioeconomic variables and 1- and 5-year relative survival was observed (Table 4). Nevertheless, the relative 1-year survival tended to be higher among women with higher education, more disposable income and a good affiliation to the work market. For 5-year relative survival, a trend was observed only for disposable income. With regard to demographic variables, a pattern of increasing 1-year relative survival was observed with increasing size of dwelling. Furthermore, single women had poorer 1- and 5-year relative survival than cohabiting and married women. In most estimates the confidence intervals overlapped.

3.7. Ovarian cancer

We included 3855 women in whom ovarian cancer was diagnosed in the period 1994–2003, representing 65% of

	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)
Level of education			
Basic or high school	2044	1.00	1.00
Vocational education	1047	1.02 (0.95–1.10)	1.00 (0.92–1.08)
Higher education	565	1.07 (0.97–1.17)	1.02 (0.92–1.12)
Unknown	29	0.77 (0.53–1.10)	0.76 (0.52–1.09)
Disposable income[c]			
Lowest (1st quartile)	1088	0.94 (0.87–1.02)	0.94 (0.87–1.02)
Middle (2nd–3rd quartile)	1645	1.00	1.00
Highest (4th quartile)	952	1.11 (1.02–1.20)	1.10 (1.02–1.20)
Affiliation to work market[d]			
Working	1765	1.00	1.00
Unemployed or other	594	0.98 (0.89–1.08)	1.00 (0.91–1.11)
Early retirement pensioner	495	0.91 (0.82–1.01)	0.93 (0.84–1.04)
Social class[e]			
Creative core	46	0.97 (0.71–1.33)	0.90 (0.65–1.24)
Creative professional	311	1.15 (0.98–1.35)	1.09 (0.91–1.29)
Bohemian	7	0.98 (0.46–2.08)	0.93 (0.44–1.97)
Service	1987	1.08 (0.95–1.22)	1.05 (0.93–1.20)
Manual	283	1.00	1.00
Agricultural	75	1.01 (0.78–1.30)	1.00 (0.78–1.30)
Unknown	976	1.07 (0.94–1.23)	1.07 (0.94–1.23)
Housing tenure			
Owner-occupied	2441	1.00	1.00
Rental	1211	0.93 (0.87–1.00)	0.94 (0.88–1.01)
Unknown	33	0.88 (0.63–1.24)	0.90 (0.63–1.26)
Size of dwelling (m^2)			
0–49	43	0.80 (0.59–1.09)	0.83 (0.61–1.12)
50–99	1398	0.95 (0.88–1.02)	0.97 (0.90–1.04)
100–149	1418	1.00	1.00
$\geqslant$150	826	0.99 (0.91–1.08)	0.97 (0.89–1.06)
Cohabiting status			
Married	2448	1.00	1.00
Cohabiting	196	1.04 (0.89–1.20)	1.03 (0.89–1.20)
Single	235	1.29 (1.13–1.48)	1.31 (1.15–1.50)
Widow	505	0.97 (0.87–1.07)	0.98 (0.88–1.08)
Divorced	301	0.76 (0.67–0.85)	0.78 (0.69–0.88)
Type of district			
Capital area	1192	1.00	1.00
Provincial city	1848	0.94 (0.88–1.01)	0.96 (0.89–1.03)
Rural area	450	1.01 (0.91–1.13)	1.04 (0.93–1.16)
Peripheral rural area[f]	195	0.95 (0.82–1.10)	0.97 (0.84–1.14)
Ethnicity[g]			
Danish	3685	1.00	1.00
Immigrant or descendant from western country	83	0.89 (0.71–1.10)	0.89 (0.72–1.11)
Immigrant or descendant from non-western country	58	0.79 (0.61–1.03)	0.91 (0.68–1.20)
Charlson comorbidity index[h]			
None	3212	1.00	1.00
1	313	0.89 (0.79–1.00)	0.90 (0.80–1.01)
$\geqslant$2	160	0.81 (0.69–0.95)	0.82 (0.70–0.96)
Depression			
No	3599	1.00	1.00
Yes	86	0.70 (0.57–0.87)	0.71 (0.57–0.88)
Schizophrenia or other psychoses			
No	3647	1.00	1.00
Yes	38	0.85 (0.62–1.17)	0.87 (0.63–1.19)

Table 3 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for endometrial cancer in Danish women born in 1925–1973 and aged $\geqslant$30 years, by socioeconomic, demographic and health-related variables, Denmark, 1994–2003

a Adjusted for calendar period (in 5-year intervals) and age modelled as age and age^2 in years.
b Adjusted for calendar period and age (as above) and additionally for level of education and disposable income.

Table 3 – *continued*

c Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.

d For pensioners, work market affiliation before pension date was assigned and followed up to age 69.

e Based on theory of creative class (18): the creative core (e.g. researchers, designers, architects), creative professionals (e.g. managers, business and finance, lawyers, doctors), bohemians (e.g. artists, models), the service class (e.g. nurses, hairdressers, caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers, fishermen).

f More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.

g Included as a separate indicator, but ethnic groups were excluded from the study population in all other analyses presented in Table 3, e.g. education and income.

h The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[10] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.
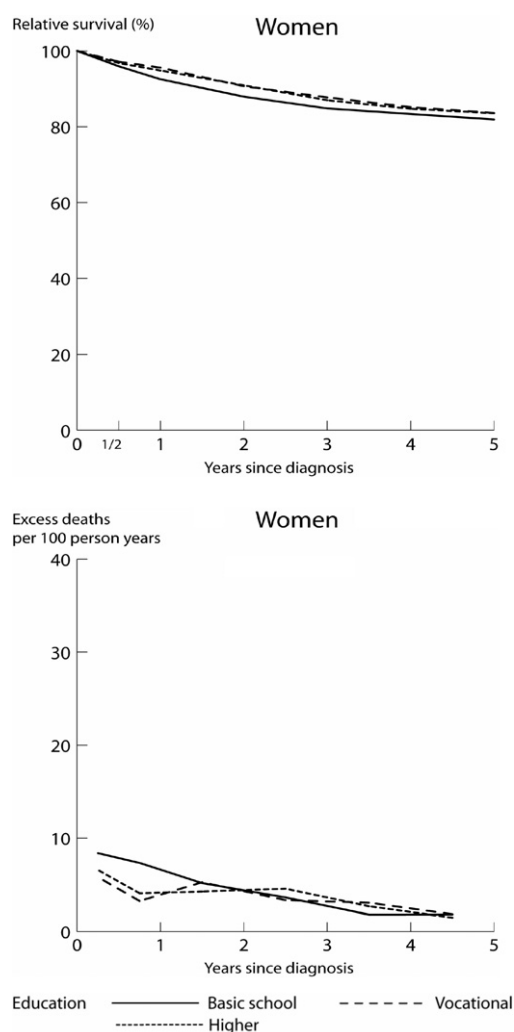

Fig. 4 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born in 1925–1973, with endometrial cancer diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients and the survival that would have been expected if the patients had had the same age-, period- and education-specific mortality as the total study population. Excess mortality is excess to the same population mortality and estimated in intervals since diagnosis. Estimates were standardised for age on the basis of the age distribution of all patients with endometrial cancer in the study cohort.

the total number of ovarian cancer cases diagnosed in Denmark during that period. Among Danish women, the age- and period-standardised incidence rate was 30 per 100,000 women-years.

3.8. Incidence of ovarian cancer

Fig. 5 shows an increasing age- and period-standardised incidence rate of ovarian cancer with age. Although no consistent or major differences by educational level were apparent, a tendency towards a slightly higher incidence with higher education was observed, especially among older women. The incidence rate difference between women with higher education and those with basic schooling was 2 per 100,000 person-years.

When the IRR of ovarian cancer was adjusted for period, age, education and disposable income, it was slightly increased (of borderline statistical significance) for women with higher income compared to those with middle income (Table 5). Furthermore, the IRR was related to the type of housing tenure: women living in rented housing had a slightly higher (of borderline significance) IRR of ovarian cancer than women living in owner-occupied housing. Single women had a significantly higher IRR of ovarian cancer than married women. There were no consistent trends in the IRR of ovarian cancer associated with level of education, affiliation to the work market, social class, size of dwelling, type of district, ethnicity, Charlson comorbidity index, depression or schizophrenia or other psychoses.

3.9. Relative survival from ovarian cancer

For patients in whom ovarian cancer was diagnosed in the period 1994–2003, the 1-year relative survival was 77% and the 5-year relative survival was 37%.

Fig. 6 shows that the age-standardised relative survival decreased markedly with time after diagnosis. More than 1-year after diagnosis, relative survival was slightly better among women with vocational education. The excess mortality curves reveal that in the first 6 months after diagnosis the excess mortality rate was the highest for women with basic schooling and the lowest for those with higher education; however, the excess mortality rate was higher for women with higher education 1–3 years after diagnosis, and no major differences according to educational level were observed subsequently.

Table 4 – 1-year and 5-year relative survival[a] (%) with 95% confidence interval (95% CI) by socioeconomic, demographic and health variables in patients aged ⩾30 years born in 1925–1973, with endometrial cancer diagnosed in Denmark between 1994 and 2003 and followed through 2006

	Women				
	No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI
Level of education					
Basic or high school	2041	93	91–94	79	77–81
Vocational education	1047	96	94–97	81	78–84
Higher education	565	95	93–97	81	77–85
Unknown	29	97	89–105	85	70–104
Disposable income[b]					
Lowest (1st quartile)	1087	92	90–94	77	74–80
Middle (2nd–3rd quartile)	1643	94	93–96	82	79–84
Highest (4th quartile)	952	96	95–98	83	80–86
Affiliation to work market[c]					
Working	1765	96	95–97	87	85–88
Unemployed or other	593	96	95–98	86	82–89
Early retirement pensioner	494	93	89–96	86	81–91
Social class[d]					
Creative core	46	95	88–102	93	85–103
Creative professional	311	97	95–99	82	76–87
Bohemian	7	34	–	35	–
Service	1986	94	93–95	80	78–82
Manual	283	91	88–95	75	70–81
Agricultural	75	93	87–100	87	78–96
Unknown	974	92	90–94	80	77–83
Housing tenure					
Owner-occupied	2439	94	93–95	81	79–83
Rental	1210	92	90–94	78	75–81
Unknown	33	85	71–103	74	56–99
Size of dwelling (m²)					
0–49	43	93	84–103	82	67–100
50–99	1396	92	91–93	77	75–80
100–149	1417	94	93–95	81	79–84
⩾150	826	96	94–97	83	80–87
Cohabiting status					
Married	2446	94	93–95	81	79–83
Cohabiting	196	94	91–98	79	72–86
Single	234	88	83–93	70	63–78
Widow	505	92	89–95	78	73–83
Divorced	301	93	90–96	79	74–85
Type of district					
Capital area	1192	94	92–95	80	78–83
Provincial city	1845	94	92–95	80	78–82
Rural area	450	92	89–94	79	74–83
Peripheral rural area[e]	195	95	92–98	83	77–89
Ethnicity[f]					
Danish	3682	94	93–94	80	79–82
Immigrant or descendant from western country	83	94	89–100	74	64–85
Immigrant or descendant from non-western country	58	82	70–95	58	48–71
Charlson comorbidity index[g]					
None	3210	94	93–94	79	78–81
1	312	94	91–97	85	80–91
⩾2	160	90	85–96	76	67–86
Depression					
No	3596	94	93–94	80	78–81
Yes	86	93	87–100	80	70–92

Table 4 – continued

	No.	Women			
		1-year survival		5-year survival	
		%	95% CI	%	95% CI
Schizophrenia or other psychoses					
No	3645	94	93–94	80	79–82
Yes	37	81	67–97	64	47–88

a Ratio of observed survival of cancer patients and survival that would have been expected if the patients had had the same age-, period-, socioeconomic, demographic or health-related indicator-specific mortality as the total study population; for 'social class' and 'ethnicity', expected survival is adjusted only for age, not period, because of low power.

b Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.

c For pensioners, work market affiliation before pension date was assigned and followed up to age 69.

d Based on theory of creative class (18): the creative core (e.g. researchers, designers, architects), creative professionals (e.g. managers, business and finance, lawyers, doctors), bohemians (e.g. artists, models), the service class (e.g. nurses, hairdressers, caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers, fishermen).

e More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.

f Excluded from the study population in all other analyses presented in Table 4.

g The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[10] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.

Incidence rate	Basic school	Vocational	Higher
	(*n* = 1948)	(*n* = 1095)	(*n* = 639)
Crude	35	27	23
Standardised	30	30	32
Difference	0	0	2

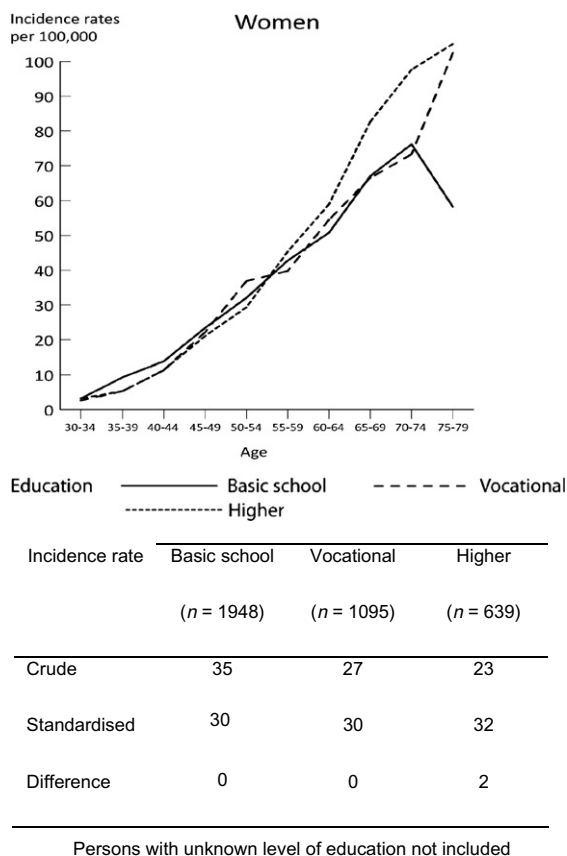Persons with unknown level of education not included

Fig. 5 – Age-specific incidence rates per 100,000 person-years for ovarian cancer by education among persons born in 1925–1973, Denmark, 1994–2003. Supplementary table shows the crude incidence rate and the incidence rate standardised by age (5-year age groups) and period (two 5-year periods) with the total study population as the standard and the incidence rate difference with higher education as the reference.

As shown in Table 6, short-term relative survival tended to be lower among women in less advantaged groups in regard to the level of education, disposable income, affiliation to the work market, size of dwelling, Charlson comorbidity index and the presence of schizophrenia or other psychoses, most estimates being statistically significant or of borderline significance. In addition, married women tended to have better short-term relative survival, although this was not statistically significant. The long-term survival also tended to be poor in less advantaged groups in respect of disposable income, affiliation to the work market, size of dwelling and comorbidity (Charlson comorbidity index, depression and schizophrenia or other psychoses). In addition, we observed higher relative survival among married and cohabiting women and women living in peripheral rural areas. For long-term relative survival, only affiliation to the work market was statistically significant.

4.   Discussion

Our results show an increasing incidence of cervical cancer with decreasing socioeconomic position, which is consistent with the results of studies elsewhere.[5,8,9] The incidence of cervical cancer increased with almost all the variables used to assess socioeconomic position (level of education, disposable income, affiliation to the work market, housing tenure, size of dwelling). It is somewhat surprising that immigrants and descendants from non-western countries had a lower IRR than Danish women, as they are generally considered to be underserved in terms of health care; however, the finding is based on small numbers. The incidences of endometrial cancer and ovarian cancer were to some extent related to socioeconomic factors, with increasing IRRs among women of increasing socioeconomic position. The IRR of endometrial cancer increased with greater disposable income. The absence of somatic chronic disorders and of depression resulted in increased IRRs of endometrial cancer. The incidence of

Table 5 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for ovarian cancer in Danish women born in 1925–1973 and aged ⩾30 years, by socioeconomic, demographic and health-related variables, Denmark, 1994–2003

	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)
Level of education			
Basic or high school	1948	1.00	1.00
Vocational education	1095	1.01 (0.94–1.09)	1.00 (0.93–1.08)
Higher education	639	1.05 (0.96–1.15)	1.03 (0.93–1.13)
Unknown	36	0.92 (0.66–1.28)	0.92 (0.66–1.28)
Disposable income[c]			
Lowest (1st quartile)	1039	0.98 (0.90–1.06)	0.98 (0.91–1.07)
Middle (2nd–3rd quartile)	1700	1.00	1.00
Highest (4th quartile)	979	1.07 (0.99–1.16)	1.06 (0.98–1.15)
Affiliation to work market[d]			
Working	2005	1.00	1.00
Unemployed or other	588	0.99 (0.90–1.09)	1.01 (0.91–1.11)
Early retirement pensioner	463	0.94 (0.84–1.04)	0.95 (0.85–1.06)
Social class[e]			
Creative core	70	1.11 (0.86–1.44)	1.06 (0.80–1.39)
Creative professional	319	1.00 (0.85–1.17)	0.96 (0.81–1.14)
Bohemian	5	0.57 (0.23–1.38)	0.55 (0.23–1.33)
Service	2103	1.00 (0.89–1.13)	0.99 (0.88–1.12)
Manual	313	1.00	1.00
Agricultural	68	0.90 (0.70–1.18)	0.90 (0.69–1.17)
Unknown	840	0.95 (0.83–1.08)	0.94 (0.83–1.08)
Housing tenure			
Owner-occupied	2400	1.00	1.00
Rental	1273	1.04 (0.97–1.12)	1.05 (0.98–1.13)
Unknown	45	1.18 (0.88–1.58)	1.19 (0.89–1.60)
Size of dwelling (m^2)			
0–49	51	0.97 (0.73–1.28)	0.98 (0.74–1.30)
50–99	1431	1.05 (0.98–1.14)	1.07 (0.99–1.15)
100–149	1399	1.00	1.00
⩾150	837	0.99 (0.91–1.08)	0.98 (0.90–1.07)
Cohabiting status			
Married	2380	1.00	1.00
Cohabiting	241	1.07 (0.93–1.22)	1.07 (0.93–1.22)
Single	278	1.37 (1.21–1.55)	1.39 (1.22–1.58)
Widow or widower	451	1.07 (0.96–1.19)	1.08 (0.97–1.20)
Divorced	368	0.97 (0.87–1.08)	0.99 (0.89–1.11)
Type of district			
Capital area	1151	1.00	1.00
Provincial city	1929	1.02 (0.95–1.10)	1.03 (0.96–1.11)
Rural area	440	1.03 (0.92–1.15)	1.04 (0.93–1.16)
Peripheral rural area[f]	198	1.02 (0.88–1.19)	1.04 (0.89–1.21)
Ethnicity[g]			
Danish	3718	1.00	1.00
Immigrant or descendant from western country	78	0.84 (0.67–1.05)	0.84 (0.67–1.05)
Immigrant or descendant from non-western country	59	0.69 (0.53–0.89)	0.70 (0.54–0.92)
Charlson comorbidity index[h]			
None	3265	1.00	1.00
1	290	0.92 (0.82–1.04)	0.93 (0.82–1.04)
⩾2	163	0.93 (0.80–1.09)	0.94 (0.80–1.10)
Depression			
No	3612	1.00	1.00
Yes	106	0.93 (0.77–1.13)	0.94 (0.77–1.14)
Schizophrenia or other psychoses			
No	3675	1.00	1.00
Yes	43	0.96 (0.71–1.30)	0.98 (0.72–1.32)

a Adjusted for calendar period (in 5-year intervals) and age modelled as age and age^2 in years.
b Adjusted for calendar period and age (as above) and additionally for level of education and disposable income.

Table 5 – continued

c Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.

d For pensioners, work market affiliation before pension date was assigned and followed up to age 69.

e Based on theory of creative class (18): the creative core (e.g. researchers, designers, architects), creative professionals (e.g. managers, business and finance, lawyers, doctors), bohemians (e.g. artists, models), the service class (e.g. nurses, hairdressers, caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers, fishermen).

f More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.

g Included as a separate indicator, but ethnic groups were excluded from the study population in all other analyses presented in Table 5, e.g. education and income.

h The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[10] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.
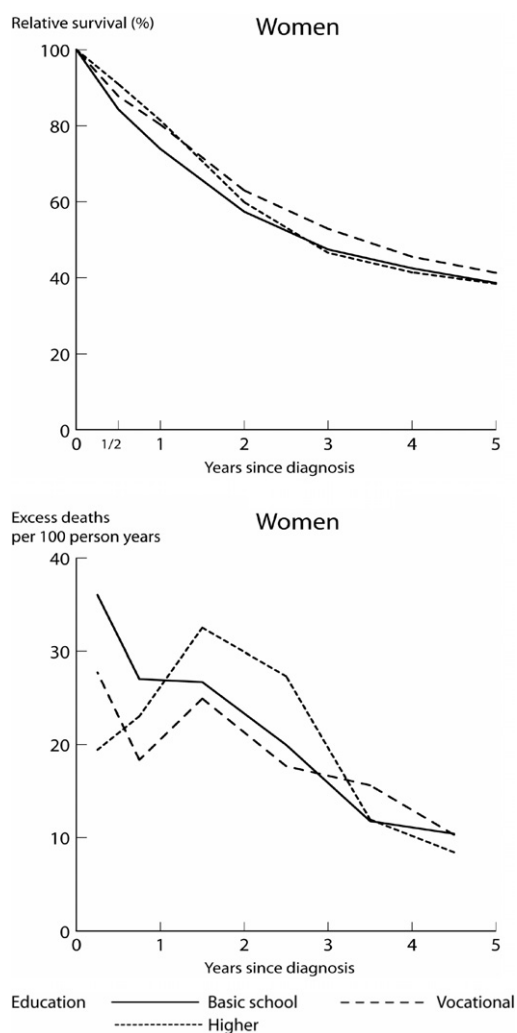

Fig. 6 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born in 1925–1973, with ovarian cancer diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients and the survival that would have been expected if the patients had had the same age-, period- and education-specific mortality as the total study population. Excess mortality is excess to the same population mortality and estimated in intervals since diagnosis. Estimates were standardised for age on the basis of the age distribution of all patients with ovarian cancer in the study cohort.

ovarian cancer was slightly increased among women with higher income, but it was also increased among women living in rented housing and in single women, indicating a disadvantage with decreasing socioeconomic position. The associations between socioeconomic position and risks for endometrial cancer and ovarian cancer have not been widely studied, and the results have been inconclusive: some studies found increased risks among women of high socioeconomic position, whereas others observed inconsistent or no trend.[8,9]

The social gradient in the incidence of cervical cancer might be explained partly by differences in sexual habits, and thereby HPV infection, and differences in compliance with cervical cancer screening.[5,6,8] One study has shown, however, that even after HPV status and number of screenings are taken into account, there is still a difference in the incidence between women of high and low socioeconomic position.[12] Well-known risk factors for endometrial cancer are the use of oestrogens, anovulation, parity, obesity, physical inactivity, use of oral contraceptives and smoking;[13] factors associated with ovarian cancer risk include genetic disposition, parity and use of hormone replacement therapy and oral contraceptives.[14–16] As there is no clear trend in the distribution of these risk factors according to socioeconomic position, the observed associations between the incidences of endometrial cancer and ovarian cancer and the socioeconomic position can only partly be explained by variations in their prevalence.

A recent overview of trends in population-based incidence of and mortality from female genital cancers in Europe shows that both the incidence of and the mortality from cervical cancer in Denmark are higher than in almost all other countries in northern, western and southern Europe. Slovenia was the only country in which the incidence rate was higher, while both Ireland and Slovenia had higher mortality rates.[17] A similar pattern was seen for ovarian cancer, where the incidence rate in Denmark was only exceeded by those in the United Kingdom and Ireland, while Denmark had the highest mortality rate even in comparison with countries in central Europe.[17] The incidence and mortality rates for endometrial cancer in Denmark were comparable to those in most northern and western European countries but lower than the rates in most central and southern European countries. Denmark had the lowest incidence rate but the highest mortality rate for endometrial cancer among the Scandinavian countries.[17]

In line with the results of previous studies,[7,9] we found that both short- and longer-term relative survival after a diagnosis of cervical cancer decreased with decreasing

Table 6 – 1-year and 5-year relative survival[a] (%) with 95% confidence interval (95% CI) by socioeconomic, demographic and health variables in patients aged ⩾30 years born in 1925–1973, with ovarian cancer diagnosed in Denmark between 1994 and 2003 and followed through 2006

	No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI
Level of education					
Basic or high school	1942	74	72–76	37	34–39
Vocational education	1094	80	78–83	39	36–42
Higher education	638	81	78–85	36	32–40
Unknown	35	67	53–86	43	30–64
Disposable income[b]					
Lowest (1st quartile)	1035	73	70–76	36	32–39
Middle (2nd–3rd quartile)	1696	77	75–79	37	35–39
Highest (4th quartile)	978	82	79–85	39	35–42
Affiliation to work market[c]					
Working	2004	88	87–89	48	46–50
Unemployed or other	585	82	78–85	48	44–53
Early retirement pensioner	459	71	66–77	35	29–41
Social class[d]					
Creative core	69	83	74–94	43	35–55
Creative professional	319	78	74–83	36	31–42
Bohemian	5	89	76–104	80	67–96
Service	2099	79	78–81	38	36–40
Manual	313	72	67–77	39	34–45
Agricultural	68	82	73–91	44	35–54
Unknown	836	72	69–75	33	29–37
Housing tenure					
Owner-occupied	2397	78	76–80	38	36–40
Rental	1268	76	74–78	36	33–39
Unknown	44	65	51–81	46	32–67
Size of dwelling (m^2)					
0–49	49	64	50–82	34	23–50
50–99	1426	75	72–77	35	33–38
100–149	1399	78	76–80	38	35–40
⩾150	835	81	78–84	39	36–43
Cohabiting status					
Married	2375	80	78–81	38	36–40
Cohabiting	241	73	67–80	40	33–47
Single	276	74	68–80	31	26–38
Widow	451	72	65–80	36	28–47
Divorced	366	74	69–79	32	28–37
Type of district					
Capital area	1148	79	76–81	35	33–38
Provincial city	1924	77	75–79	38	36–40
Rural area	439	75	71–79	36	31–41
Peripheral rural area[e]	198	77	72–83	41	35–48
Ethnicity[f]					
Danish	3709	77	76–79	37	36–39
Immigrant or descendant from western country	78	84	76–93	30	21–42
Immigrant or descendant from non-western country	59	75	64–88	42	30–59
Charlson comorbidity index[g]					
None	3257	79	77–80	38	36–39
1	289	71	66–76	33	27–40
⩾2	163	63	56–71	32	25–41
Depression					
No	3605	77	76–79	37	36–39
Yes	104	76	68–85	33	25–43
Schizophrenia or other psychoses					
No	3670	77	76–79	37	36–39
Yes	39	58	44–76	22	12–41

Table 6 – continued
a Ratio of observed survival of cancer patients and survival that would have been expected if the patients had had the same age-, period-, socioeconomic, demographic or health-related indicator-specific mortality as the total study population; for 'social class' and 'ethnicity', expected survival is adjusted only for age, not period, because of low power.
b Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.
c For pensioners, work market affiliation before pension date was assigned and followed up to age 69.
d Based on theory of creative class (18): the creative core (e.g. researchers, designers, architects), creative professionals (e.g. managers, business and finance, lawyers, doctors), bohemians (e.g. artists, models), the service class (e.g. nurses, hairdressers, caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers, fishermen).
e More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.
f Excluded from the study population in all other analyses presented in Table 6.
g The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[10] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.

socioeconomic position. A review by Kogevinas et al.[7] showed that the survival of patients with endometrial or ovarian cancer tended to be the highest for women in higher socioeconomic groups, as shown to some extent in this study. Although initially there appeared to be a social gradient in excess mortality rates for both endometrial and ovarian cancer beyond the second and third years, respectively, the differences by length of education appeared to level out. In addition, the multivariate analyses for endometrial and ovarian cancer showed that relative survival tended to be better for women with higher education and more disposable income; however, these trends were observed mainly for 1-year relative survival.

We were unable to take account of stage at diagnosis; however, it is likely that the social gradient in excess mortality rate during the first 2 years for cervical cancer patients, the first 1–2 years for endometrial cancer patients and the first 6 months for ovarian cancer patients might be due to the fact that women of higher socioeconomic position benefit more from earlier diagnosis and treatment options, resulting in a differential stage distribution by socioeconomic position, leading to the short-term survival differences we observed in this study.

As it is to be hoped that the incidence of and mortality from cancers of the female genital organs will improve in Denmark to the levels observed in most other European countries, it is important to ensure that the gain occurs similarly in all socioeconomic and demographic groups of society.

Conflict of interest statement

None declared.

Acknowledgement

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