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# Social inequality and incidence of and survival from tumours of the central nervous system 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 tumours of the central nervous system (CNS) diagnosed in 1994–2003 with follow-up through 2006 in Denmark using information from nationwide Danish administrative registers. The analyses were based on data on 5622 patients with CNS tumours in a cohort of 2.7 million people born between 1925 and 1973 and aged ⩾30 years. Socioeconomic and demographic factors were not associated with the incidence of CNS tumours, except for a significantly increased incidence rate ratio (IRR) amongst men in the agricultural class (IRR, 1.23; 95% CI, 1.04–1.45). The 1- and 5-year survival was significantly longer in higher socioeconomic groups, as assessed by education, income, affiliation to the work market and size of dwelling.

Socioeconomic position does not affect the incidence of CNS tumours but appears to be a prognostic factor for survival from CNS tumours in Denmark.



## 1. Introduction

Tumours of the central nervous system (CNS) are rare; however, the incidence rates have increased during the past few decades in both men and women.[1] The increased incidence may be explained by improved diagnostic methods and by a lower threshold for performing diagnostic computed tomography or magnetic resonance image scanning; however, unknown risk factors may also play a role. In 2003, 922 new cases of CNS tumours were diagnosed in Denmark.[2] The results of studies of an association between incidence and socioeconomic position (SEP) are conflicting: several reported increased incidences of CNS tumours amongst persons with higher SEP,[3–5] whilst others found no association with SEP.[6,7]

Age and tumour characteristics are known to be important prognostic factors for survival,[8] but the effect of SEP has been investigated only rarely.[9–11] The aim of this study was to investigate the effects of various socioeconomic indicators on the incidence of and survival from CNS tumours in Denmark on the basis of information from population-based, nationwide Danish administrative registers. It was carried out as part of a comprehensive, rigorous analysis of the role of socioeconomic position in cancer incidence and survival.

## 2. Material and methods

The material and methods are described elsewhere.[12] Briefly, the study population comprised all Danish residents born between 1925 and 1973 without a previous cancer and who entered the cohort at age 30 (see Fig. 1 in [12]) Information on socioeconomic, demographic and health-related indicators was obtained from various Danish administrative registers.[12] Crude, age-specific and age-standardised incidence rates

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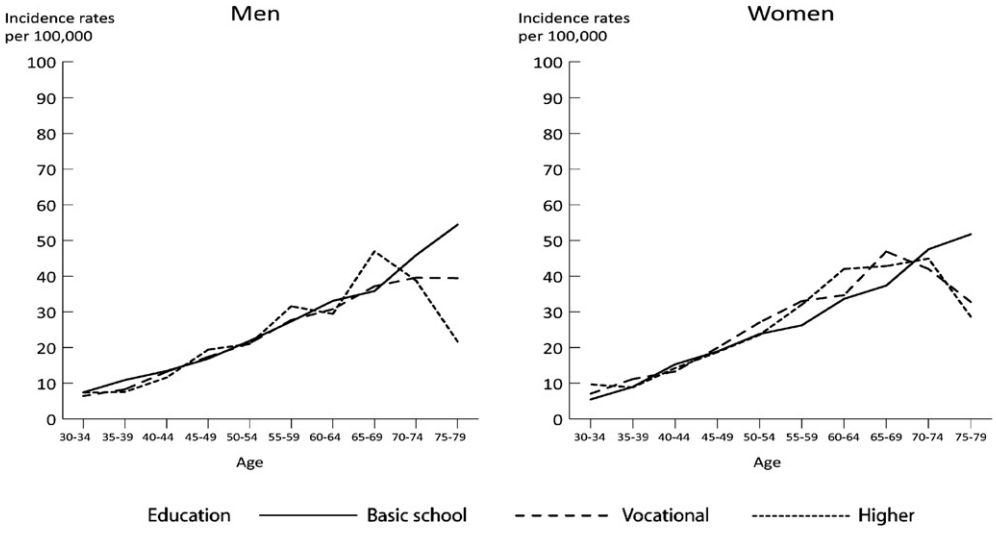
are presented for CNS tumours (ICD-10 C70–C72, D32–D33, D42–43) diagnosed in the cohort in 1994–2003. In a subset of the data, the tumours were restricted to malignant tumours of the CNS defined as described in the WHO classification.[13] The incidence rates were standardised by age (in 5-year age groups) and period (in two 5-year periods), with the total study population as the standard.[14] 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 second by adding education and disposable income to the models. For each level of each indicator, we conducted relative survival analyses, adjusting for population mortality amongst the incident CNS tumour cases in 1994–2003 with follow-up through 2006.[12] 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.[12]

## 3. Results

We included 5622 persons in whom a CNS tumour was diagnosed during the study period 1994–2003, of which 2391 were malignant tumours. Amongst Danish persons, the male:female ratio for all CNS tumours was 0.90, and that for malignant tumours was 1.4. The age- and period-standardised incidence rate was 20 per 100,000 person-years for men and 22 per 100,000 person-years for women.

### 3.1. *Incidence of CNS tumours*

Age was a strong risk factor for CNS tumours. There was no clear effect of level of education on the incidence rates by age, for either men or women (Fig. 1), and in fact none of the socioeconomic and demographic variables evaluated in this study had a strong effect on the IRR. Nevertheless, small but significant increases in the IRR were observed for men in the agricultural class and for those in the highest income




| Incidence rate | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Basic school | Vocational | Higher | Basic school | Vocational | Higher |
| | ($n$ = 987) | ($n$ = 1023) | ($n$ = 495) | ($n$ = 1341) | ($n$ = 898) | ($n$ = 534) |
| Crude | 22 | 19 | 19 | 24 | 22 | 19 |
| Standardised | 20 | 20 | 21 | 21 | 23 | 23 |
| Difference | 0 | 0 | 1 | 0 | 2 | 2 |

Persons with unknown level of education not included

**Fig. 1 – Age-specific incidence rates per 100,000 person-years for CNS tumour by education amongst persons born in 1925–1973, diagnosed in 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.**

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

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Obs | IRR[a] (95% CI) | Adjusted IRR[b] (95% CI) | Obs | IRR[a] (95% CI) | Adjusted IRR[b] (95% CI) |
| *Level of education* | | | | | | |
| Basic or high school | 987 | 1.00 | 1.00 | 1341 | 1.00 | 1.00 |
| Vocational education | 1023 | 0.95 (0.87–1.04) | 0.95 (0.87–1.03) | 898 | 1.11 (1.02–1.21) | 1.11 (1.02–1.21) |
| Higher education | 495 | 1.00 (0.89–1.11) | 0.96 (0.86–1.08) | 534 | 1.09 (0.98–1.21) | 1.09 (0.98–1.22) |
| Unknown | 43 | 1.09 (0.81–1.48) | 1.09 (0.80–1.47) | 30 | 1.06 (0.73–1.52) | 1.05 (0.73–1.52) |
| *Disposable income*[c] | | | | | | |
| Lowest (1st quartile) | 652 | 1.03 (0.93–1.13) | 1.02 (0.92–1.13) | 763 | 1.03 (0.94–1.13) | 1.05 (0.95–1.15) |
| Middle (2nd–3rd quartile) | 1162 | 1.00 | 1.00 | 1310 | 1.00 | 1.00 |
| Highest (4th quartile) | 734 | 1.13 (1.03–1.24) | 1.14 (1.03–1.25) | 730 | 1.04 (0.95–1.14) | 1.03 (0.93–1.13) |
| *Affiliation to work market*[d] | | | | | | |
| Working | 1804 | 1.00 | 1.00 | 1634 | 1.00 | 1.00 |
| Unemployed or other | 229 | 0.91 (0.79–1.04) | 0.92 (0.80–1.07) | 417 | 0.98 (0.88–1.09) | 1.00 (0.89–1.12) |
| Early retirement pensioner | 173 | 1.03 (0.88–1.21) | 1.05 (0.89–1.24) | 337 | 1.05 (0.93–1.19) | 1.10 (0.97–1.25) |
| *Social class*[e] | | | | | | |
| Creative core | 180 | 1.18 (1.01–1.39) | 1.17 (0.97–1.42) | 55 | 1.01 (0.75–1.36) | 0.94 (0.69–1.29) |
| Creative professional | 422 | 1.04 (0.92–1.16) | 1.03 (0.91–1.16) | 260 | 1.06 (0.88–1.26) | 0.99 (0.82–1.20) |
| Bohemian | 14 | 1.02 (0.60–1.73) | 1.01 (0.59–1.72) | 9 | 1.25 (0.64–2.43) | 1.19 (0.61–2.32) |
| Service | 593 | 0.97 (0.88–1.07) | 0.97 (0.87–1.07) | 1585 | 1.00 (0.87–1.15) | 0.96 (0.84–1.11) |
| Manual | 990 | 1.00 | 1.00 | 231 | 1.00 | 1.00 |
| Agricultural | 164 | 1.24 (1.05–1.47) | 1.23 (1.04–1.45) | 64 | 1.27 (0.97–1.68) | 1.27 (0.96–1.67) |
| Unknown | 185 | 0.96 (0.82–1.12) | 0.95 (0.81–1.11) | 599 | 1.04 (0.89–1.21) | 1.03 (0.88–1.20) |
| *Housing tenure* | | | | | | |
| Owner-occupied | 1814 | 1.00 | 1.00 | 1823 | 1.00 | 1.00 |
| Rental | 701 | 0.99 (0.91–1.08) | 0.99 (0.91–1.09) | 948 | 1.04 (0.96–1.13) | 1.05 (0.97–1.14) |
| Unknown | 33 | 0.88 (0.62–1.24) | 0.88 (0.62–1.24) | 32 | 1.04 (0.73–1.48) | 1.05 (0.74–1.49) |
| *Size of dwelling ($m^2$)* | | | | | | |
| 0–49 | 61 | 0.72 (0.56–0.94) | 0.72 (0.56–0.94) | 32 | 0.75 (0.53–1.07) | 0.76 (0.53–1.08) |
| 50–99 | 767 | 0.98 (0.89–1.08) | 0.98 (0.90–1.08) | 1025 | 1.02 (0.93–1.11) | 1.02 (0.94–1.12) |
| 100–149 | 1022 | 1.00 | 1.00 | 1086 | 1.00 | 1.00 |
| ⩾150 | 698 | 1.05 (0.95–1.15) | 1.04 (0.94–1.14) | 660 | 1.00 (0.91–1.10) | 0.99 (0.90–1.10) |
| *Cohabiting status* | | | | | | |
| Married | 1783 | 1.00 | 1.00 | 1840 | 1.00 | 1.00 |
| Cohabiting | 222 | 0.92 (0.80–1.07) | 0.92 (0.80–1.06) | 219 | 0.99 (0.86–1.15) | 1.00 (0.87–1.16) |
| Single | 298 | 1.02 (0.90–1.16) | 1.02 (0.89–1.16) | 174 | 0.93 (0.79–1.09) | 0.93 (0.79–1.09) |
| Widow or widower | 65 | 0.97 (0.75–1.24) | 0.97 (0.76–1.25) | 298 | 1.10 (0.97–1.26) | 1.11 (0.97–1.26) |
| Divorced | 180 | 0.90 (0.77–1.05) | 0.91 (0.78–1.06) | 272 | 0.96 (0.85–1.09) | 0.96 (0.84–1.09) |
| *Type of district* | | | | | | |
| Capital area | 812 | 1.00 | 1.00 | 981 | 1.00 | 1.00 |
| Provincial city | 1295 | 0.94 (0.86–1.03) | 0.95 (0.87–1.04) | 1368 | 0.85 (0.79–0.93) | 0.86 (0.79–0.93) |
| Rural area | 318 | 0.96 (0.84–1.09) | 0.97 (0.85–1.10) | 315 | 0.86 (0.76–0.98) | 0.87 (0.77–0.99) |
| Peripheral rural area[f] | 123 | 0.84 (0.70–1.02) | 0.85 (0.70–1.03) | 139 | 0.86 (0.72–1.03) | 0.87 (0.73–1.04) |
| *Ethnicity*[g] | | | | | | |
| Danish | 2548 | 1.00 | 1.00 | 2803 | 1.00 | 1.00 |
| Immigrant or descendant from western country | 53 | 0.99 (0.76–1.31) | 0.99 (0.75–1.30) | 72 | 1.05 (0.83–1.33) | 1.03 (0.81–1.30) |
| Immigrant or descendant from non-western country | 68 | 0.90 (0.71–1.15) | 0.90 (0.70–1.15) | 78 | 1.05 (0.84–1.31) | 1.00 (0.78–1.27) |
| *Charlson comorbidity index*[h] | | | | | | |
| None | 2117 | 1.00 | 1.00 | 2471 | 1.00 | 1.00 |
| 1 | 291 | 1.17 (1.03–1.33) | 1.18 (1.04–1.34) | 202 | 0.96 (0.83–1.11) | 0.96 (0.83–1.11) |
| ⩾2 | 140 | 1.19 (1.00–1.42) | 1.20 (1.01–1.43) | 130 | 1.12 (0.94–1.34) | 1.13 (0.95–1.35) |
| *Depression* | | | | | | |
| No | 2505 | 1.00 | 1.00 | 2704 | 1.00 | 1.00 |
| Yes | 43 | 1.09 (0.80–1.47) | 1.10 (0.81–1.48) | 99 | 1.26 (1.03–1.55) | 1.27 (1.04–1.56) |

**Table 1 – *continued***

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Obs | IRR[a] (95% CI) | Adjusted IRR[b] (95% CI) | Obs | IRR[a] (95% CI) | Adjusted IRR[b] (95% CI) |
| *Schizophrenia or other psychosis* | | | | | | |
| No | 2528 | 1.00 | 1.00 | 2774 | 1.00 | 1.00 |
| Yes | 20 | 0.77 (0.50–1.20) | 0.78 (0.50–1.21) | 29 | 0.88 (0.61–1.26) | 0.89 (0.62–1.28) |

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.

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 follow-up to age 69.

e Based on theory of creative class[24]: 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 this table, 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[12] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

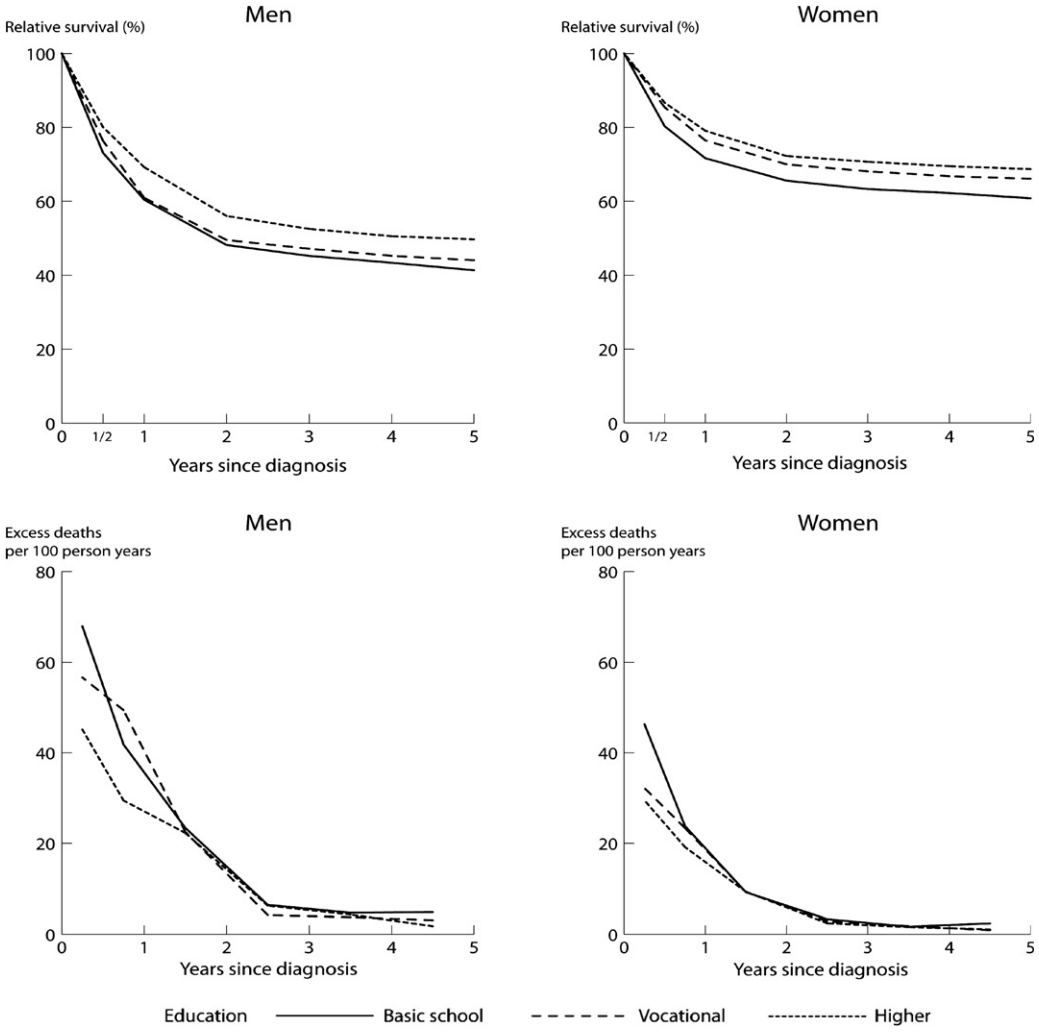



**Fig. 2 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born in 1925–1973, with CNS tumour diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients and 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 CNS tumour in the study cohort.**

**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 CNS tumour diagnosed in Denmark between 1994 and 2003 and followed through 2006**

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-year survival | | 5-year survival | | | 1-year survival | | 5-year survival | |
| | No. | % | 95% CI | % | 95% CI | No. | % | 95% CI | % | 95% CI |
| *Level of education* | | | | | | | | | | |
| Basic or high school | 974 | 60 | 58–63 | 39 | 36–42 | 1336 | 72 | 69–74 | 58 | 55–61 |
| Vocational education | 1015 | 61 | 58–64 | 41 | 38–44 | 893 | 76 | 74–79 | 63 | 60–67 |
| Higher education | 494 | 69 | 65–74 | 47 | 43–52 | 532 | 79 | 75–83 | 66 | 62–71 |
| Unknown | 42 | 66 | 53–84 | 38 | 26–57 | 30 | 76 | 62–94 | 71 | 55–93 |
| *Disposable income*[b] | | | | | | | | | | |
| Lowest (1st quartile) | 643 | 60 | 56–64 | 42 | 38–46 | 761 | 72 | 69–76 | 58 | 54–62 |
| Middle (2nd–3rd quartile) | 1152 | 61 | 58–64 | 40 | 37–43 | 1302 | 75 | 73–78 | 62 | 59–64 |
| Highest (4th quartile) | 730 | 67 | 63–70 | 43 | 39–47 | 728 | 76 | 72–80 | 65 | 61–70 |
| *Affiliation to work market*[c] | | | | | | | | | | |
| Working | 1791 | 73 | 71–75 | 50 | 48–52 | 1630 | 83 | 81–85 | 69 | 67–72 |
| Unemployed or other | 228 | 71 | 64–78 | 45 | 38–54 | 415 | 84 | 80–88 | 71 | 66–76 |
| Early retirement pensioner | 168 | 59 | 51–69 | 39 | 31–51 | 332 | 75 | 69–82 | 64 | 56–73 |
| *Social class*[d] | | | | | | | | | | |
| Creative core | 180 | 72 | 66–79 | 51 | 44–59 | 55 | 74 | 64–85 | 57 | 44–73 |
| Creative professional | 421 | 63 | 59–68 | 42 | 38–47 | 258 | 80 | 75–86 | 68 | 62–75 |
| Bohemian | 14 | 74 | 62–88 | 56 | 46–69 | 9 | 40 | – | 13 | – |
| Service | 590 | 65 | 62–69 | 43 | 39–47 | 1579 | 74 | 72–77 | 61 | 58–63 |
| Manual | 981 | 58 | 55–61 | 38 | 35–41 | 230 | 77 | 72–83 | 63 | 57–71 |
| Agricultural | 161 | 69 | 62–75 | 47 | 40–56 | 64 | 71 | 61–83 | 55 | 42–71 |
| Unknown | 178 | 57 | 50–65 | 38 | 30–48 | 596 | 72 | 68–76 | 61 | 56–66 |
| *Housing tenure* | | | | | | | | | | |
| Owner-occupied | 1802 | 64 | 61–66 | 42 | 40–45 | 1813 | 75 | 73–77 | 62 | 60–64 |
| Rental | 691 | 59 | 55–62 | 39 | 35–43 | 946 | 74 | 71–77 | 60 | 57–64 |
| Unknown | 32 | 47 | 33–68 | 26 | 14–49 | 32 | 60 | 46–79 | 55 | 40–75 |
| *Size of dwelling ($m^2$)* | | | | | | | | | | |
| 0–49 | 60 | 51 | 40–65 | 39 | 29–54 | 31 | 62 | 48–80 | 56 | 41–76 |
| 50–99 | 756 | 60 | 56–63 | 38 | 35–42 | 1023 | 73 | 70–75 | 60 | 56–63 |
| 100–149 | 1018 | 62 | 59–65 | 41 | 38–44 | 1079 | 75 | 73–78 | 62 | 59–65 |
| ⩾150 | 691 | 66 | 62–69 | 45 | 41–49 | 658 | 76 | 73–80 | 63 | 59–67 |
| *Cohabiting status* | | | | | | | | | | |
| Married | 1773 | 63 | 61–65 | 41 | 39–44 | 1834 | 74 | 72–76 | 61 | 59–64 |
| Cohabiting | 221 | 59 | 52–68 | 41 | 34–50 | 218 | 78 | 71–85 | 70 | 62–78 |
| Single | 292 | 58 | 52–65 | 38 | 32–45 | 172 | 76 | 69–83 | 62 | 54–71 |
| Widow/widower | 63 | 66 | 55–79 | 51 | 41–63 | 297 | 71 | 62–81 | 57 | 46–71 |
| Divorced | 176 | 57 | 50–65 | 38 | 31–47 | 270 | 70 | 65–76 | 54 | 48–61 |
| *Type of district* | | | | | | | | | | |
| Capital area | 806 | 61 | 58–65 | 39 | 36–43 | 980 | 75 | 72–78 | 61 | 58–65 |
| Provincial city | 1282 | 62 | 60–65 | 42 | 39–45 | 1358 | 74 | 72–76 | 62 | 60–65 |
| Rural area | 316 | 64 | 59–69 | 45 | 39–51 | 314 | 74 | 70–79 | 59 | 54–65 |
| Peripheral rural area[e] | 121 | 63 | 56–70 | 40 | 32–50 | 139 | 70 | 63–78 | 57 | 49–66 |
| *Ethnicity*[f] | | | | | | | | | | |
| Danish | 2525 | 62 | 60–64 | 41 | 39–43 | 2791 | 74 | 73–76 | 61 | 59–63 |
| Immigrant or descendant from western country | 53 | 68 | 58–80 | 55 | 44–69 | 72 | 87 | 79–95 | 65 | 55–78 |
| Immigrant or descendant from non-western country | 68 | 70 | 56–87 | 47 | 35–63 | 78 | 85 | 77–93 | 72 | 62–84 |
| *Charlson comorbidity index*[g] | | | | | | | | | | |
| None | 2102 | 63 | 61–65 | 42 | 40–44 | 2461 | 75 | 73–77 | 62 | 60–64 |
| 1 | 288 | 58 | 52–64 | 35 | 29–43 | 201 | 72 | 66–79 | 60 | 53–69 |
| ⩾2 | 135 | 62 | 54–71 | 38 | 28–51 | 129 | 73 | 67–81 | 55 | 46–66 |

**Table 2 – *continued***

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-year survival | | 5-year survival | | | 1-year survival | | 5-year survival | |
| | No. | % | 95% CI | % | 95% CI | No. | % | 95% CI | % | 95% CI |
| *Depression* | | | | | | | | | | |
| No | 2482 | 62 | 60–64 | 41 | 39–43 | 2694 | 74 | 73–76 | 61 | 59–63 |
| Yes | 43 | 70 | 57–85 | 53 | 39–74 | 97 | 74 | 67–83 | 63 | 54–75 |
| *Schizophrenia or other psychosis* | | | | | | | | | | |
| No | 2505 | 62 | 60–64 | 41 | 39–43 | 2762 | 74 | 73–76 | 61 | 59–63 |
| Yes | 20 | 48 | 30–76 | 28 | 15–53 | 29 | 76 | 60–95 | 63 | 46–88 |

a Ratio of observed survival of CNS tumour 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 follow-up to age 69.
d Based on theory of creative class (24): 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 this table.
g The presence of, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[12] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

quartile. Amongst women in the agricultural class the increased IRR was nonsignificant. A Charlson index score of 1 or more was associated with a higher IRR of CNS tumours in men, and a score of 2 or more was associated with a nonsignificant increase amongst women. The IRR amongst women was highest for those living in the capital area and those with diagnosed depression (Table 1). Diagnoses of schizophrenia and other psychotic diseases were associated with nonsignificantly decreased IRRs for CNS tumours in both sexes (Table 1).

An association between a previous diagnosis of chronic somatic disease and risk for CNS tumours was not apparent when only malignant tumours were analysed (data not shown).

### 3.2. *Relative survival after CNS tumours*

The 1-year relative survival after a CNS tumour was 62% for men and 74% for women, and that 5 years after diagnosis was 41% for men and 61% for women. The 1-year relative survival after diagnosis of a malignant tumour was 47% (95% CI, 45–50%) for men and 48% (95% CI, 45–51%) for women, and that after 5 years was 17% (95% CI, 15–19%) for men and 21% (95% CI, 19–24%) for women (data not shown).

Fig. 2 shows that the relative survival rates for men and women differed when both malignant and benign CNS tumours were included in the analyses. Nearly half the male patients died within the first 2 years, and most male patients died within the first 6 months after diagnosis. For women, the pattern was similar, but survival was generally longer. A difference in relative survival rate by educational level was seen for both the sexes after the first 6 months (Fig. 2). Fig. 2 also shows that the excess mortality rate was highest for men with basic schooling or vocational education in comparison with patients with higher education in the first 18 months after diagnosis. At later times, no clear difference by educational level was observed for men or women.

We observed a socioeconomic gradient in the age-standardised 1- and 5-year relative survival rates of both the sexes when measured by the social indicators education, size of dwelling and affiliation to the work market. A similar gradient with increasing relative survival rates with increasing social level was seen by social class, although for women only an effect in the 5-year relative survival rate was present. High income was associated with a higher relative survival rate although only significant for men after 1 year and women after 5 years (Table 2).

## 4. Discussion

Overall, we observed no major effects of socioeconomic position or demographic factors on the incidence of CNS tumours, in line with the previous reports from large Scandinavian register-based cohort studies,[6,7,15] as well as a large, recently published case–control study,[16] in which occupational title or educational level was used as the indicator of SEP.[6,7,15] A number of case–control studies have given conflicting results, with an increasing risk with increasing socioeconomic position when occupational title was used as the sole social indicator.[3–5,17] In a more recent interview-based case-control study, an increasing incidence of benign tumours but not malignant tumours was associated with increasing income and education.[18]

The increased IRR for CNS tumours observed amongst men assigned to the agricultural social class is in line with the results of several previous studies,[19,20] and is probably a result of occupational exposure rather than socioeconomic position. A high incidence of CNS tumours was observed amongst Danish farmers in the 1970s.[6]

Marital status has previously been shown to affect survival, with a slightly lower rate amongst single persons.[8,21] We did not observe any difference by demographic factors, apart from better survival of descendants of immigrants from non-western countries, based, however, on only small numbers.

Both short-term (1-year) and long-term (5-year) survival was better amongst women than men. This may reflect the fact that meningioma, which has a better prognosis than gliomas, is more frequent amongst women.[1] This conclusion is further supported by the observation that the large difference in survival between the sexes vanished when the analysis was restricted to malignant tumours.

We found that socioeconomic position, as assessed by level of education, size of dwelling, income, affiliation to the work market and amongst men additionally social class, is a prognostic factor for survival after a CNS tumour in Denmark. Our findings are in line with the results of the few previous studies that reported better survival after a CNS tumour in more socially advantaged groups. In a large cohort study in Finland in which social class were classified by occupation, social class IV had slightly poorer survival than social class I, but the result did not reach significance (RR, 0.79; 95% CI, 0.59–1.05).[9]

A similar pattern was observed in a cohort study in the United Kingdom of 30,489 patients with glioma, in which socioeconomic position was based on the Carstairs index.[10,22] The most affluent patients with CNS tumours had better survival than the most deprived patients, the effect being most pronounced during the first year after diagnosis.

In previous studies, social inequalities in cancer survival have been attributed partly to a greater burden of chronic somatic comorbidity in disadvantaged groups.[23] This has not to the best of our knowledge been evaluated by studying actual comorbidity in patients with CNS tumours. Excess somatic comorbidity cannot explain all the observed differences in the present study, as only decreased long-term survival in women was associated with the Charlson comorbidity index.

Better compliance with public health policies, including earlier contact with the health system resulting in earlier diagnosis, by patients with a higher socioeconomic position might explain the differences in relative survival rates by socioeconomic position; however, we had no information about the tumour size or disease stage at the time of diagnosis. Alternatively, the observed differences in survival after diagnosis of a CNS tumour might be due to differences in access to treatment, time to surgery and referral to or compliance with adjuvant treatment in our public health system.

## Conflict of interest statement

None declared.

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