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# Social inequality and incidence of and survival from Hodgkin lymphoma, non-Hodgkin lymphoma and leukaemia 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 haematological cancers diagnosed in 1994–2003 with follow-up through 2006 in Denmark using information from nationwide registers. The analyses were based on data on 636 patients with Hodgkin lymphoma (HL), 4516 with non-Hodgkin lymphoma (NHL) and 3486 with leukaemia in a cohort of 3.22 million people born between 1925 and 1973 and aged ⩾30 years. No consistent differences in incidence were seen by socioeconomic position, but an association with comorbidity was found. Patients in the lowest socioeconomic groups and those with other serious illnesses, especially men, had a worse survival of NHL. Survival results for leukaemia tended to be similar to those for NHL, although associations were generally weaker and insignificant. Thus, there were no strong associations between socioeconomic position and the incidence of these cancers; survival after NHL might be affected.



## 1. Introduction

The haematological neoplasms Hodgkin lymphoma (HL), non-Hodgkin lymphoma (NHL) and leukaemia are a diverse group of cancers from the point of view of descriptive epidemiology. Whereas HL is rare, with only 137 cases diagnosed in Denmark in 2003, NHL and leukaemia are commoner, with 826 and 717 cases, respectively, diagnosed in 2003.[1] The incidence rates of NHL increased in many parts of the world until the mid-1990s, when they stabilised.[1–3] There is no clear evidence for an association between the incidence of NHL or leukaemia and socioeconomic position.[3–7] The incidence of HL has been positively associated with higher socioeconomic position; the association has mainly been seen amongst young adult cases, and several studies investigated associations with higher childhood socioeconomic position or markers of socioeconomic position (e.g. less crowded housing and smaller sibship).[8–10]

The haematological neoplasms also present a diverse picture with regard to survival. The 5-year relative survival was 80% for HL, 53% for NHL and 39% for leukaemia diagnosed amongst European adults in 1990–1994, who were included in the EUROCARE-3 Study.[11] The results of the few studies that have been conducted on survival after haematological neoplasms and socioeconomic position are inconsistent.[12–15]

The aim of the study reported here was to elucidate whether the incidence of and survival from HL, NHL and leukaemia are associated with socioeconomic, demographic or health-related indicators. It was carried out as part of a

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comprehensive, rigorous analysis of the role of socioeconomic position in cancer incidence and survival.

## 2. Materials and methods

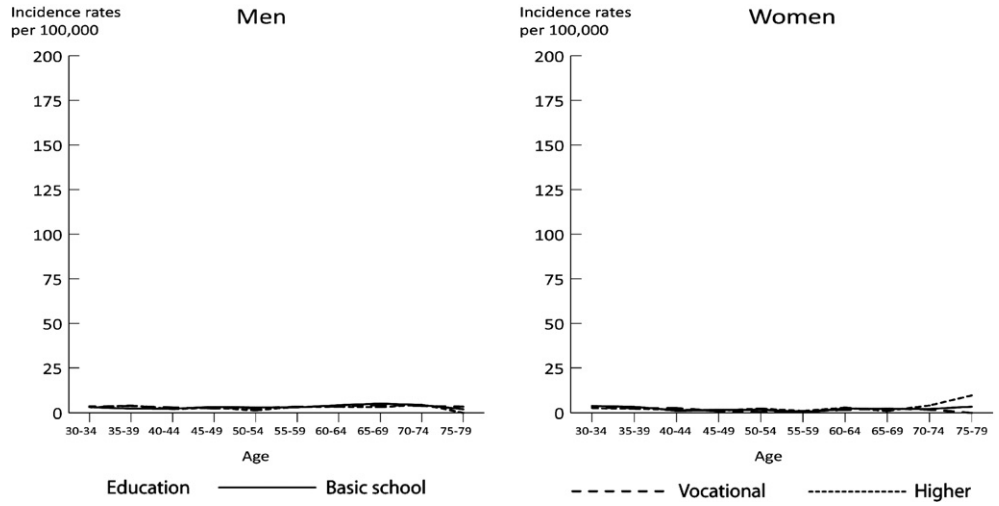
The material and methods are described elsewhere.[16] Briefly, the study population comprised all 3.22 million Danish residents born between 1925 and 1973 without a previous history of cancer and who entered the cohort at age 30 (see Fig. 1 in[16]). Information on socioeconomic, demographic and health-related indicators was obtained from various Danish registers based on administrative data.[16] Crude, age-specific and age-standardised incidence rates were calculated for HL (ICD-10: C81), NHL (C82–C85, C96) and leukaemia (C91–C95) and for subtypes of leukaemia: acute leukaemia (C91.0, C92.0, C93.0, C94.0, C95.0), and other leukaemia (C91–C95 except C9X.0) 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.[17] 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 amongst the incident cancer cases in 1994–2003 with follow-up through 2006.[16] 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.[16]

## 3. Results

### 3.1. *Hodgkin lymphoma*

HL was diagnosed in 636 persons in the cohort during the study period, constituting 52% of all cases of HL diagnosed in Denmark in that period.[1] Amongst Danish persons, the male:female ratio was 1.67, and the age- and period-standardised incidence rate was 3 per 100,000 person-years for men and 2 per 100,000 person-years for women. The 1-year relative survival was 90% for men and 93% for women, and the relative survival 5 years after diagnosis was 78% for men and 82% for women.

The age- and period-standardised incidence rates of HL did not differ by educational level for either men or women (Fig. 1). The adjusted IRRs for HL did not show a clear pattern of association with indicators of socioeconomic position, but tended to be higher amongst men with the lowest disposable income than those with middle income, amongst those renting compared to those owning housing and amongst those




| Incidence rate | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Basic school ($n$ =138 ) | Vocational ($n$ =166 ) | Higher ($n$ =69 ) | Basic school ($n$ =105 ) | Vocational ($n$ =67) | Higher ($n$ =51 ) |
| Crude | 3 | 3 | 3 | 2 | 2 | 2 |
| Standardised | 3 | 3 | 3 | 2 | 2 | 2 |
| Difference | 0 | 0 | 0 | 0 | 0 | 0 |

Persons with unknown level of education not included

**Fig. 1 – Age-specific incidence rates per 100,000 person-years for Hodgkin lymphoma by education among persons born in 1925–1973, Denmark, diagnosed in 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 Hodgkin lymphoma in Danish persons born 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 | 138 | 1.00 | 1.00 | 105 | 1.00 | 1.00 |
| Vocational education | 166 | 1.02 (0.81–1.28) | 1.04 (0.83–1.31) | 67 | 0.83 (0.61–1.14) | 0.81 (0.59–1.11) |
| Higher education | 69 | 0.89 (0.67–1.20) | 0.95 (0.70–1.28) | 51 | 0.92 (0.65–1.30) | 0.86 (0.60–1.23) |
| Unknown | 4 | 0.69 (0.26–1.88) | 0.69 (0.26–1.87) | 3 | 1.25 (0.40–3.95) | 1.25 (0.40–3.93) |
| *Disposable income*[c] | | | | | | |
| Lowest (1st quartile) | 109 | 1.24 (0.97–1.59) | 1.24 (0.97–1.59) | 54 | 0.95 (0.68–1.32) | 0.92 (0.65–1.28) |
| Middle (2nd–3rd quartile) | 181 | 1.00 | 1.00 | 112 | 1.00 | 1.00 |
| Highest (4th quartile) | 87 | 0.96 (0.74–1.24) | 0.97 (0.74–1.26) | 60 | 1.20 (0.88–1.65) | 1.23 (0.89–1.70) |
| *Affiliation to work market*[d] | | | | | | |
| Working | 276 | 1.00 | 1.00 | 154 | 1.00 | 1.00 |
| Unemployed or other | 43 | 1.19 (0.86–1.65) | 1.12 (0.80–1.56) | 33 | 0.92 (0.63–1.35) | 0.92 (0.62–1.37) |
| Early retirement pensioner | 26 | 1.33 (0.88–2.00) | 1.26 (0.83–1.93) | 19 | 1.10 (0.66–1.84) | 1.10 (0.65–1.87) |
| *Social class*[e] | | | | | | |
| Creative core | 22 | 0.85 (0.55–1.33) | 1.01 (0.60–1.68) | 4 | 0.71 (0.24–2.12) | 0.67 (0.21–2.08) |
| Creative professional | 63 | 1.03 (0.77–1.37) | 1.12 (0.81–1.54) | 23 | 1.28 (0.69–2.41) | 1.26 (0.64–2.47) |
| Bohemian | 3 | 1.33 (0.42–4.15) | 1.48 (0.47–4.70) | 0 | – | – |
| Service | 86 | 0.86 (0.66–1.12) | 0.89 (0.68–1.17) | 136 | 1.15 (0.69–1.91) | 1.18 (0.71–1.98) |
| Manual | 158 | 1.00 | 1.00 | 17 | 1.00 | 1.00 |
| Agricultural | 13 | 0.69 (0.39–1.22) | 0.67 (0.38–1.19) | 4 | 1.45 (0.49–4.32) | 1.48 (0.50–4.42) |
| Unknown | 32 | 1.00 (0.68–1.46) | 0.99 (0.68–1.46) | 42 | 1.28 (0.72–2.26) | 1.29 (0.73–2.29) |
| *Housing tenure* | | | | | | |
| Owner-occupied | 236 | 1.00 | 1.00 | 145 | 1.00 | 1.00 |
| Rental | 131 | 1.30 (1.05–1.61) | 1.29 (1.04–1.60) | 78 | 1.00 (0.75–1.32) | 1.00 (0.76–1.33) |
| Unknown | 10 | 1.67 (0.88–3.15) | 1.63 (0.86–3.08) | 3 | 0.93 (0.30–2.92) | 0.93 (0.30–2.92) |
| *Size of dwelling ($m^2$)* | | | | | | |
| 0–49 | 15 | 1.11 (0.65–1.90) | 1.06 (0.62–1.83) | 7 | 1.41 (0.65–3.04) | 1.41 (0.65–3.06) |
| 50–99 | 146 | 1.33 (1.05–1.68) | 1.32 (1.04–1.67) | 73 | 0.83 (0.61–1.13) | 0.84 (0.61–1.14) |
| 100–149 | 137 | 1.00 | 1.00 | 95 | 1.00 | 1.00 |
| ⩾150 | 79 | 0.92 (0.70–1.22) | 0.93 (0.70–1.23) | 51 | 0.95 (0.67–1.33) | 0.94 (0.67–1.32) |
| *Cohabiting status* | | | | | | |
| Married | 228 | 1.00 | 1.00 | 130 | 1.00 | 1.00 |
| Cohabiting | 65 | 1.41 (1.05–1.89) | 1.43 (1.06–1.91) | 31 | 0.99 (0.66–1.49) | 0.95 (0.63–1.44) |
| Single | 56 | 1.03 (0.76–1.41) | 1.00 (0.73–1.36) | 27 | 1.11 (0.72–1.70) | 1.14 (0.74–1.77) |
| Widow or widower | 5 | 0.74 (0.30–1.81) | 0.71 (0.29–1.74) | 23 | 2.05 (1.23–3.42) | 2.11 (1.26–3.53) |
| Divorced | 23 | 0.95 (0.62–1.45) | 0.89 (0.58–1.38) | 15 | 0.90 (0.53–1.54) | 0.96 (0.56–1.66) |
| *Type of district* | | | | | | |
| Capital area | 126 | 1.00 | 1.00 | 64 | 1.00 | 1.00 |
| Provincial city | 197 | 0.94 (0.75–1.18) | 0.92 (0.73–1.15) | 120 | 1.18 (0.87–1.60) | 1.21 (0.89–1.64) |
| Rural area | 36 | 0.73 (0.50–1.05) | 0.70 (0.48–1.01) | 32 | 1.40 (0.92–2.15) | 1.44 (0.94–2.21) |
| Peripheral rural area[f] | 18 | 0.85 (0.52–1.39) | 0.80 (0.49–1.32) | 10 | 1.04 (0.53–2.03) | 1.07 (0.55–2.10) |
| *Ethnicity*[g] | | | | | | |
| Danish | 377 | 1.00 | 1.00 | 226 | 1.00 | 1.00 |
| Immigrant or descendant from western country | 6 | 0.73 (0.33–1.64) | 0.74 (0.33–1.66) | 5 | 0.99 (0.41–2.40) | 1.02 (0.42–2.48) |
| Immigrant or descendant from non–western country | 13 | 0.91 (0.52–1.58) | 0.87 (0.49–1.55) | 9 | 1.00 (0.51–1.96) | 1.12 (0.56–2.25) |
| *Charlson comorbidity index*[h] | | | | | | |
| None | 318 | 1.00 | 1.00 | 200 | 1.00 | 1.00 |
| 1 | 31 | 1.12 (0.76–1.63) | 1.10 (0.75–1.61) | 10 | 0.83 (0.44–1.58) | 0.83 (0.44–1.58) |
| ⩾2 | 28 | 2.19 (1.47–3.27) | 2.16 (1.45–3.23) | 16 | 2.41 (1.43–4.06) | 2.41 (1.43–4.07) |
| *Depression* | | | | | | |
| No | 372 | 1.00 | 1.00 | 221 | 1.00 | 1.00 |
| Yes | 5 | 1.01 (0.42–2.46) | 0.99 (0.41–2.40) | 5 | 1.07 (0.44–2.61) | 1.08 (0.44–2.64) |

**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 | 373 | 1.00 | 1.00 | 222 | 1.00 | 1.00 |
| Yes | 4 | 0.99 (0.37–2.64) | 0.96 (0.36–2.57) | 4 | 1.68 (0.63–4.52) | 1.69 (0.63–4.55) |

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:[23] 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[16] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

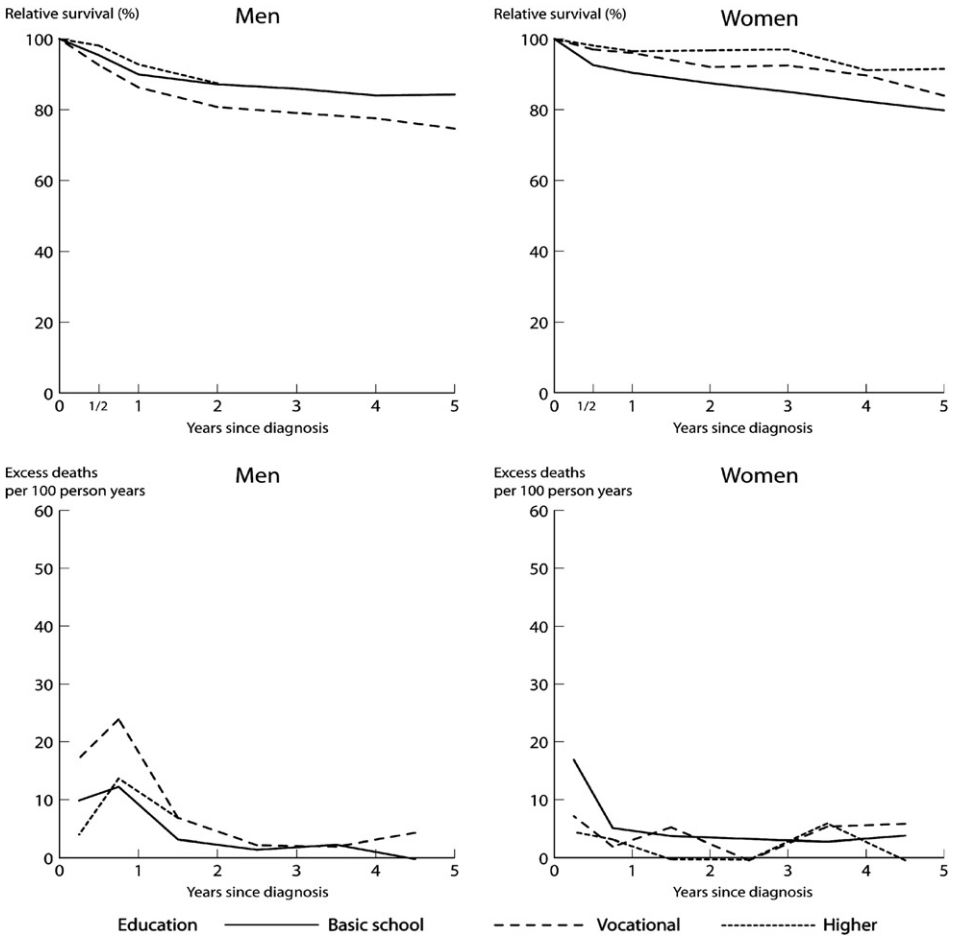



**Fig. 2 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born in 1925–1973, with Hodgkin lymphoma diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients 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 Hodgkin lymphoma in the study cohort. The survival curve and the excess mortality rate curve among men with higher educational level were truncated at 2 years after diagnosis, because there were too few persons left to estimate the survival or rate beyond that time.**

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

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | 1-year survival | | 5-year survival | | No. | 1-year survival | | 5-year survival | |
| | | % | 95% CI | % | 95% CI | | % | 95% CI | % | 95% CI |
| *Level of education* | | | | | | | | | | |
| Basic or high school | 138 | 90 | 85–95 | 82 | 75–89 | 105 | 90 | 85–96 | 78 | 70–87 |
| Vocational education | 165 | 86 | 82–91 | 73 | 67–80 | 67 | 96 | 90–102 | 82 | 71–95 |
| Higher education | 68 | 93 | 87–99 | 76 | 66–87 | 51 | 97 | 92–101 | 90 | 80–101 |
| Unknown | 4 | 101 | – | 90 | 75–107 | 3 | 101 | – | 104 | – |
| *Disposable income*[b] | | | | | | | | | | |
| Lowest (1st quartile) | 108 | 91 | 86–96 | 78 | 70–86 | 54 | 93 | 86–101 | 81 | 69–95 |
| Middle (2nd–3rd quartile) | 180 | 90 | 86–95 | 79 | 73–86 | 112 | 92 | 86–98 | 81 | 73–90 |
| Highest (4th quartile) | 87 | 91 | 86–97 | 78 | 69–89 | 60 | 94 | 88–100 | 87 | 79–96 |
| *Affiliation to work market*[c] | | | | | | | | | | |
| Working | 276 | 95 | 93–98 | 86 | 82–90 | 154 | 98 | 96–101 | 91 | 86–96 |
| Unemployed or other | 43 | 91 | 82–100 | 85 | 74–98 | 33 | 97 | 91–103 | 93 | 84–103 |
| Early retirement pensioner | 26 | 82 | 65–104 | 87 | 67–114 | 19 | 72 | 47–109 | 64 | 38–110 |
| *Social class*[d] | | | | | | | | | | |
| Creative core | 22 | 100 | – | 95 | 85–106 | 4 | 100 | – | 100 | – |
| Creative professional | 63 | 84 | 76–94 | 66 | 55–79 | 23 | 97 | 92–103 | 90 | 79–102 |
| Bohemian | 3 | 90 | – | 91 | – | 0 | – | – | – | – |
| Service | 86 | 90 | 84–96 | 81 | 73–90 | 136 | 94 | 90–99 | 85 | 78–91 |
| Manual | 156 | 92 | 88–96 | 80 | 74–87 | 17 | 101 | – | 58 | 41–82 |
| Agricultural | 13 | 101 | – | 103 | – | 4 | 50 | 32–78 | 51 | 33–80 |
| Unknown | 32 | 89 | 78–101 | 71 | 55–90 | 42 | 86 | 74–99 | 77 | 62–95 |
| *Housing tenure* | | | | | | | | | | |
| Owner-occupied | 235 | 92 | 89–96 | 81 | 76–87 | 145 | 95 | 91–98 | 85 | 79–91 |
| Rental | 130 | 87 | 81–93 | 74 | 67–82 | 78 | 89 | 81–98 | 77 | 66–89 |
| Unknown | 10 | 80 | 67–96 | 46 | 27–79 | 3 | 100 | – | 101 | – |
| *Size of dwelling ($m^2$)* | | | | | | | | | | |
| 0–49 | 15 | 94 | 82–108 | 89 | 72–109 | 7 | 100 | – | 101 | – |
| 50–99 | 145 | 88 | 82–93 | 73 | 66–81 | 73 | 93 | 86–99 | 84 | 76–94 |
| 100–149 | 136 | 91 | 87–96 | 83 | 77–90 | 95 | 90 | 84–97 | 76 | 68–86 |
| ⩾150 | 79 | 92 | 86–98 | 79 | 70–90 | 51 | 97 | 91–103 | 89 | 80–100 |
| *Cohabiting status* | | | | | | | | | | |
| Married | 226 | 92 | 89–96 | 79 | 74–85 | 130 | 96 | 93–100 | 86 | 80–93 |
| Cohabiting | 65 | 94 | 89–99 | 89 | 82–96 | 31 | 96 | 90–102 | 89 | 78–103 |
| Single | 56 | 91 | 83–101 | 87 | 75–100 | 27 | 68 | 56–83 | 56 | 41–77 |
| Widow/widower | 5 | 88 | – | 94 | – | 23 | 96 | 92–100 | 61 | 32–115 |
| Divorced | 23 | 81 | 70–93 | 64 | 49–85 | 15 | 88 | 75–104 | 88 | 73–107 |
| *Type of district* | | | | | | | | | | |
| Capital area | 126 | 83 | 78–89 | 71 | 64–79 | 64 | 94 | 88–100 | 85 | 77–94 |
| Provincial city | 195 | 93 | 90–96 | 83 | 77–88 | 120 | 93 | 88–97 | 83 | 77–91 |
| Rural area | 36 | 92 | 83–101 | 77 | 65–92 | 32 | 95 | 87–102 | 80 | 67–95 |
| Peripheral rural area[e] | 18 | 75 | 57–98 | 58 | 40–84 | 10 | 100 | – | 68 | 45–103 |
| *Ethnicity*[f] | | | | | | | | | | |
| Danish | 375 | 90 | 88–93 | 78 | 74–83 | 226 | 93 | 90–97 | 82 | 77–88 |
| Immigrant or descendant from western country | 6 | 100 | – | 84 | 68–103 | 5 | 100 | – | 93 | – |
| Immigrant or descendant from non-western country | 13 | 83 | 66–104 | 83 | 66–106 | 9 | 91 | 77–107 | 90 | 75–108 |
| *Charlson comorbidity index*[g] | | | | | | | | | | |
| None | 318 | 90 | 87–93 | 78 | 73–83 | 200 | 96 | 93–99 | 85 | 80–91 |
| 1 | 31 | 92 | 83–102 | 67 | 48–92 | 10 | 78 | 64–96 | 63 | 51–76 |
| ⩾2 | 26 | 83 | 69–101 | 83 | 65–106 | 16 | 79 | 60–104 | 81 | 59–111 |
| *Depression* | | | | | | | | | | |
| No | 370 | 90 | 87–93 | 78 | 74–83 | 221 | 93 | 90–97 | 83 | 77–88 |
| Yes | 5 | 101 | – | 58 | 25–133 | 5 | 77 | 49–119 | 60 | 29–123 |

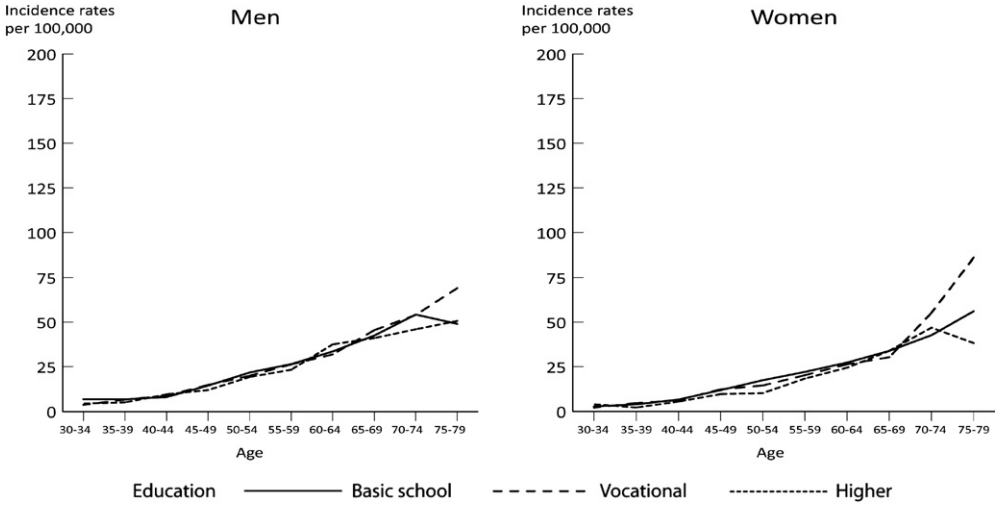
**Table 2 – *continued***

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | 1-year survival | | 5-year survival | | No. | 1-year survival | | 5-year survival | |
| | | % | 95% CI | % | 95% CI | | % | 95% CI | % | 95% CI |
| *Schizophrenia or other psychosis* | | | | | | | | | | |
| No | 371 | 90 | 87–93 | 78 | 73–82 | 222 | 93 | 89–96 | 82 | 77–88 |
| Yes | 4 | 101 | – | 107 | – | 4 | 100 | – | 102 | – |

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 follow-up to age 69.
d Based on theory of creative class:[23] 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[16] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

living in 50–99 $m^2$ as compared with 100–149 $m^2$ (Table 1). No similar associations were seen amongst women. A Charlson comorbidity score of $\geqslant 2$ compared to no score was associated with a significantly increased IRR in both sexes.

The age-standardised relative survival curves (Fig. 2) show that men with vocational school education and women with basic schooling had the worst survival, due mainly to higher mortality within the first year after diagnosis, as reflected




| Incidence rate | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Basic school (*n* =961 ) | Vocational (*n* =980 ) | Higher (*n* =421 ) | Basic school (*n* =1044 ) | Vocational (*n* =570) | Higher (*n* =276 ) |
| Crude | 22 | 18 | 16 | 19 | 14 | 10 |
| Standardised | 20 | 19 | 18 | 16 | 15 | 13 |
| Difference | 2 | 1 | 0 | 3 | 2 | 0 |

Persons with unknown level of education not included

**Fig. 3 – Age-specific incidence rates per 100,000 person-years for non-Hodgkin lymphoma by education among persons born in 1925–1973, Denmark, diagnosed in 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 3 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for non-Hodgkin lymphoma in Danish persons born 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 | 961 | 1.00 | 1.00 | 1044 | 1.00 | 1.00 |
| Vocational education | 980 | 0.99 (0.90–1.08) | 0.98 (0.90–1.08) | 570 | 1.01 (0.91–1.12) | 1.02 (0.91–1.13) |
| Higher education | 421 | 0.93 (0.83–1.04) | 0.91 (0.81–1.03) | 276 | 0.86 (0.75–0.99) | 0.88 (0.77–1.02) |
| Unknown | 38 | 1.03 (0.75–1.43) | 1.03 (0.74–1.43) | 17 | 0.84 (0.52–1.35) | 0.84 (0.52–1.36) |
| *Disposable income*[c] | | | | | | |
| Lowest (1st quartile) | 663 | 1.01 (0.92–1.12) | 1.01 (0.91–1.11) | 588 | 0.99 (0.89–1.10) | 0.98 (0.88–1.10) |
| Middle (2nd–3rd quartile) | 1095 | 1.00 | 1.00 | 903 | 1.00 | 1.00 |
| Highest (4th quartile) | 642 | 1.04 (0.94–1.14) | 1.06 (0.95–1.17) | 416 | 0.89 (0.79–1.00) | 0.91 (0.81–1.02) |
| *Affiliation to work market*[d] | | | | | | |
| Working | 1551 | 1.00 | 1.00 | 923 | 1.00 | 1.00 |
| Unemployed or other | 264 | 1.15 (1.01–1.31) | 1.15 (1.01–1.32) | 279 | 1.05 (0.92–1.21) | 1.03 (0.90–1.19) |
| Early retirement pensioner | 181 | 1.14 (0.97–1.33) | 1.14 (0.97–1.34) | 292 | 1.35 (1.17–1.55) | 1.31 (1.13–1.52) |
| *Social class*[e] | | | | | | |
| Creative core | 130 | 0.96 (0.80–1.15) | 1.03 (0.84–1.28) | 25 | 0.72 (0.47–1.10) | 0.81 (0.52–1.26) |
| Creative professional | 404 | 1.08 (0.96–1.21) | 1.12 (0.98–1.27) | 145 | 0.85 (0.68–1.05) | 0.92 (0.72–1.17) |
| Bohemian | 16 | 1.30 (0.79–2.13) | 1.36 (0.83–2.24) | 3 | 0.62 (0.20–1.94) | 0.67 (0.21–2.12) |
| Service | 619 | 1.11 (1.01–1.23) | 1.13 (1.02–1.25) | 1040 | 0.91 (0.78–1.07) | 0.92 (0.78–1.09) |
| Manual | 912 | 1.00 | 1.00 | 172 | 1.00 | 1.00 |
| Agricultural | 117 | 0.92 (0.76–1.11) | 0.91 (0.75–1.10) | 32 | 0.78 (0.53–1.13) | 0.78 (0.54–1.14) |
| Unknown | 202 | 1.10 (0.94–1.28) | 1.10 (0.94–1.29) | 490 | 0.96 (0.81–1.15) | 0.97 (0.81–1.16) |
| *Housing tenure* | | | | | | |
| Owner-occupied | 1678 | 1.00 | 1.00 | 1185 | 1.00 | 1.00 |
| Rental | 695 | 1.07 (0.98–1.17) | 1.06 (0.97–1.17) | 703 | 1.13 (1.02–1.24) | 1.11 (1.01–1.22) |
| Unknown | 27 | 0.83 (0.57–1.22) | 0.83 (0.57–1.22) | 19 | 0.99 (0.63–1.55) | 0.98 (0.62–1.54) |
| *Size of dwelling ($m^2$)* | | | | | | |
| 0–49 | 72 | 0.96 (0.76–1.22) | 0.96 (0.75–1.22) | 23 | 0.86 (0.57–1.31) | 0.86 (0.57–1.30) |
| 50–99 | 775 | 1.05 (0.96–1.16) | 1.05 (0.96–1.16) | 769 | 1.13 (1.01–1.25) | 1.11 (1.00–1.24) |
| 100–149 | 957 | 1.00 | 1.00 | 683 | 1.00 | 1.00 |
| ⩾150 | 596 | 0.95 (0.86–1.06) | 0.95 (0.86–1.06) | 432 | 1.07 (0.95–1.21) | 1.10 (0.97–1.24) |
| *Cohabiting status* | | | | | | |
| Married | 1641 | 1.00 | 1.00 | 1231 | 1.00 | 1.00 |
| Cohabiting | 213 | 1.13 (0.98–1.31) | 1.13 (0.98–1.31) | 114 | 0.93 (0.77–1.14) | 0.93 (0.77–1.13) |
| Single | 281 | 1.20 (1.06–1.37) | 1.21 (1.06–1.38) | 124 | 1.12 (0.93–1.35) | 1.13 (0.93–1.36) |
| Widow or widower | 77 | 1.06 (0.84–1.34) | 1.06 (0.84–1.34) | 234 | 0.97 (0.83–1.12) | 0.96 (0.83–1.11) |
| Divorced | 188 | 1.02 (0.88–1.19) | 1.03 (0.89–1.20) | 204 | 1.05 (0.91–1.22) | 1.04 (0.89–1.21) |
| *Type of district* | | | | | | |
| Capital area | 784 | 1.00 | 1.00 | 647 | 1.00 | 1.00 |
| Provincial city | 1172 | 0.88 (0.80–0.96) | 0.88 (0.80–0.96) | 979 | 0.92 (0.83–1.02) | 0.90 (0.82–1.00) |
| Rural area | 311 | 0.96 (0.84–1.09) | 0.95 (0.83–1.09) | 180 | 0.75 (0.63–0.88) | 0.73 (0.62–0.86) |
| Peripheral rural area[f] | 133 | 0.92 (0.76–1.10) | 0.91 (0.76–1.10) | 101 | 0.92 (0.75–1.14) | 0.90 (0.73–1.11) |
| *Ethnicity*[g] | | | | | | |
| Danish | 2400 | 1.00 | 1.00 | 1907 | 1.00 | 1.00 |
| Immigrant or descendant from western country | 53 | 1.09 (0.83–1.43) | 1.07 (0.82–1.41) | 43 | 0.91 (0.67–1.23) | 0.94 (0.69–1.27) |
| Immigrant or descendant from non-western country | 66 | 1.02 (0.80–1.30) | 0.99 (0.77–1.27) | 47 | 1.05 (0.79–1.40) | 1.14 (0.83–1.56) |
| *Charlson comorbidity index*[h] | | | | | | |
| None | 1887 | 1.00 | 1.00 | 1544 | 1.00 | 1.00 |
| 1 | 320 | 1.30 (1.15–1.47) | 1.30 (1.15–1.47) | 197 | 1.30 (1.12–1.52) | 1.29 (1.11–1.50) |
| ⩾2 | 193 | 1.63 (1.40–1.89) | 1.63 (1.40–1.89) | 166 | 1.96 (1.67–2.31) | 1.94 (1.65–2.29) |
| *Depression* | | | | | | |
| No | 2361 | 1.00 | 1.00 | 1862 | 1.00 | 1.00 |
| Yes | 39 | 0.99 (0.72–1.36) | 0.99 (0.72–1.36) | 45 | 0.76 (0.57–1.02) | 0.75 (0.56–1.01) |

**Table 3 – *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 | 2372 | 1.00 | 1.00 | 1881 | 1.00 | 1.00 |
| Yes | 28 | 1.20 (0.83–1.75) | 1.21 (0.83–1.75) | 26 | 1.15 (0.78–1.69) | 1.13 (0.77–1.66) |

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:[23] 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[16] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

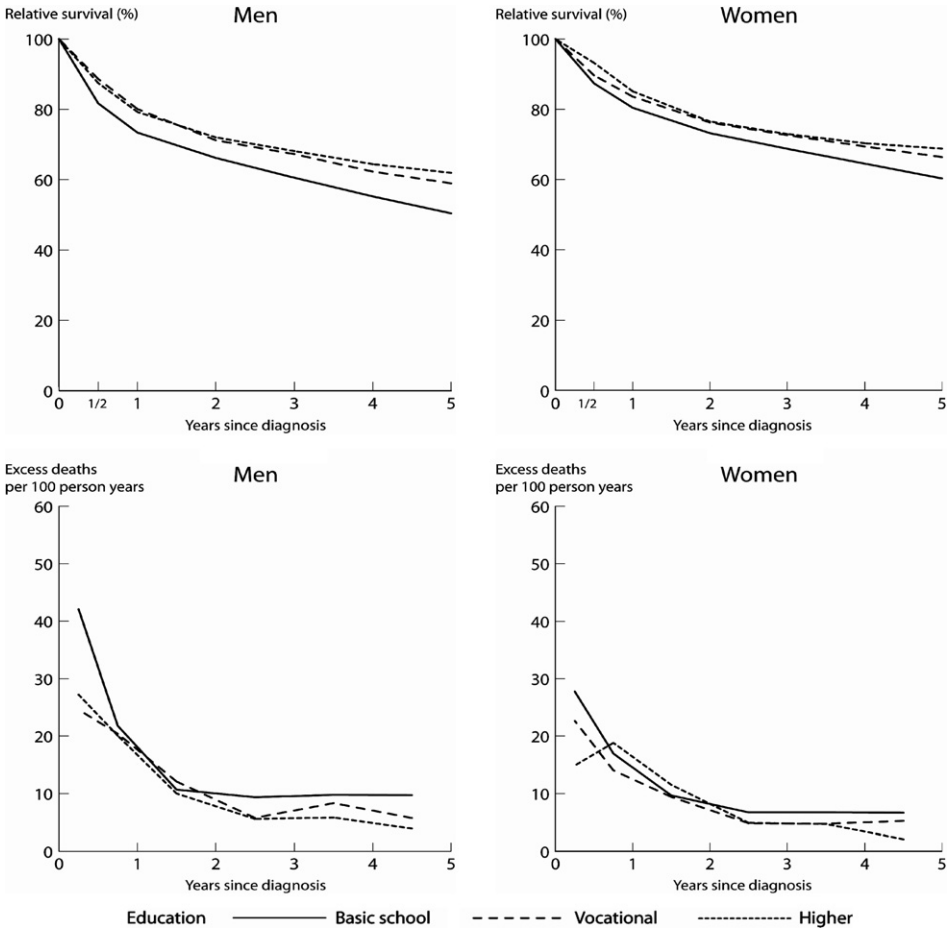



**Fig. 4 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born in 1925–1973, with non-Hodgkin lymphoma diagnosed in Denmark in 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer 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 non-Hodgkin lymphoma in the study cohort.**

**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 1925–1973, with non-Hodgkin lymphoma diagnosed in Denmark between 1994 and 2003 and followed through 2006**

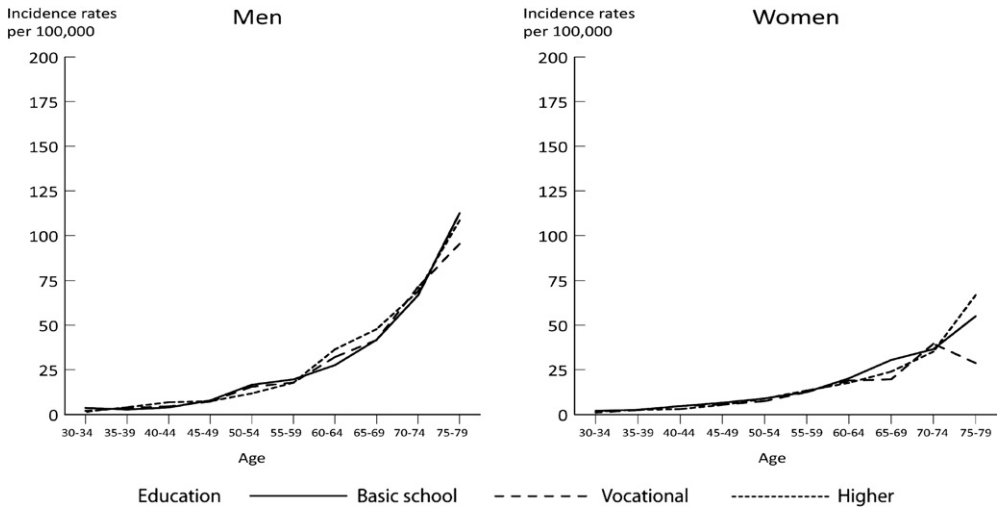
| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | 1-year survival | | 5-year survival | | No. | 1-year survival | | 5-year survival | |
| | | % | 95% CI | % | 95% CI | | % | 95% CI | % | 95% CI |
| *Level of education* | | | | | | | | | | |
| Basic or high school | 947 | 73 | 71–76 | 48 | 44–51 | 1039 | 80 | 78–83 | 58 | 55–61 |
| Vocational education | 964 | 80 | 78–83 | 56 | 52–59 | 565 | 84 | 81–87 | 64 | 60–68 |
| Higher education | 421 | 79 | 75–83 | 58 | 53–64 | 276 | 85 | 81–90 | 65 | 59–71 |
| Unknown | 38 | 86 | 76–97 | 57 | 42–76 | 16 | 98 | 92–104 | 71 | 52–95 |
| *Disposable income*[b] | | | | | | | | | | |
| Lowest (1st quartile) | 649 | 72 | 69–76 | 46 | 42–51 | 583 | 83 | 80–86 | 59 | 54–64 |
| Middle (2nd–3rd quartile) | 1082 | 79 | 76–81 | 54 | 51–58 | 897 | 81 | 78–83 | 59 | 55–62 |
| Highest (4th quartile) | 639 | 79 | 75–83 | 56 | 52–61 | 416 | 83 | 78–88 | 68 | 62–74 |
| *Affiliation to work market*[c] | | | | | | | | | | |
| Working | 1543 | 85 | 83–86 | 64 | 62–67 | 919 | 90 | 89–92 | 76 | 73–78 |
| Unemployed or other | 259 | 72 | 66–79 | 47 | 40–55 | 277 | 82 | 77–88 | 57 | 51–65 |
| Early retirement pensioner | 171 | 68 | 61–77 | 43 | 34–53 | 290 | 75 | 69–82 | 57 | 49–65 |
| *Social class*[d] | | | | | | | | | | |
| Creative core | 129 | 80 | 73–88 | 60 | 52–71 | 25 | 88 | 75–103 | 58 | 39–86 |
| Creative professional | 402 | 78 | 75–83 | 56 | 51–61 | 145 | 85 | 79–92 | 64 | 56–73 |
| Bohemian | 16 | 74 | 58–95 | 45 | 28–71 | 3 | 44 | – | 44 | – |
| Service | 612 | 78 | 75–82 | 56 | 52–61 | 1035 | 83 | 81–86 | 63 | 60–66 |
| Manual | 900 | 79 | 76–81 | 51 | 48–55 | 169 | 78 | 72–85 | 53 | 46–62 |
| Agricultural | 115 | 75 | 68–83 | 51 | 42–62 | 32 | 95 | 88–102 | 86 | 75–99 |
| Unknown | 196 | 67 | 61–74 | 39 | 32–47 | 487 | 79 | 75–84 | 58 | 53–64 |
| *Housing tenure* | | | | | | | | | | |
| Owner-occupied | 1666 | 79 | 77–81 | 56 | 53–58 | 1182 | 82 | 80–84 | 62 | 59–65 |
| Rental | 677 | 72 | 69–76 | 45 | 41–49 | 695 | 82 | 79–85 | 58 | 54–62 |
| Unknown | 27 | 81 | 65–99 | 41 | 24–71 | 19 | 95 | 84–108 | 79 | 60–104 |
| *Size of dwelling ($m^2$)* | | | | | | | | | | |
| 0–49 | 67 | 67 | 55–81 | 48 | 36–64 | 23 | 57 | 41–79 | 49 | 32–74 |
| 50–99 | 762 | 75 | 72–78 | 48 | 44–52 | 762 | 81 | 78–84 | 56 | 52–60 |
| 100–149 | 946 | 77 | 75–80 | 54 | 50–57 | 679 | 81 | 78–84 | 61 | 58–65 |
| ⩾150 | 595 | 81 | 78–84 | 57 | 53–62 | 432 | 86 | 83–90 | 66 | 61–71 |
| *Cohabiting status* | | | | | | | | | | |
| Married | 1630 | 81 | 79–83 | 56 | 54–59 | 1226 | 84 | 81–86 | 63 | 60–66 |
| Cohabiting | 212 | 76 | 69–84 | 53 | 45–63 | 114 | 85 | 77–92 | 60 | 51–71 |
| Single | 271 | 57 | 51–65 | 33 | 27–41 | 123 | 75 | 66–84 | 51 | 42–63 |
| Widow/widower | 75 | 70 | 60–82 | 43 | 27–69 | 232 | 75 | 65–87 | 51 | 39–67 |
| Divorced | 182 | 71 | 64–79 | 49 | 41–59 | 201 | 86 | 81–91 | 60 | 53–68 |
| *Type of district* | | | | | | | | | | |
| Capital area | 769 | 77 | 74–80 | 51 | 48–55 | 642 | 82 | 79–85 | 62 | 59–67 |
| Provincial city | 1160 | 77 | 75–80 | 53 | 50–56 | 975 | 84 | 81–86 | 60 | 57–64 |
| Rural area | 309 | 79 | 75–84 | 54 | 48–60 | 178 | 79 | 74–85 | 65 | 58–72 |
| Peripheral rural area[e] | 132 | 76 | 69–83 | 56 | 48–65 | 101 | 78 | 71–86 | 48 | 40–60 |
| *Ethnicity*[f] | | | | | | | | | | |
| Danish | 2370 | 77 | 76–79 | 53 | 51–55 | 1896 | 82 | 81–84 | 61 | 59–63 |
| Immigrant or descendant from western country | 53 | 71 | 59–86 | 56 | 42–76 | 42 | 81 | 70–93 | 65 | 53–80 |
| Immigrant or descendant from non-western country | 65 | 83 | 73–94 | 44 | 32–60 | 47 | 76 | 63–92 | 62 | 48–81 |
| *Charlson comorbidity index*[g] | | | | | | | | | | |
| None | 1874 | 79 | 77–81 | 54 | 52–56 | 1537 | 84 | 82–86 | 63 | 61–66 |
| 1 | 315 | 75 | 70–81 | 52 | 46–59 | 195 | 76 | 68–83 | 53 | 45–63 |
| ⩾2 | 181 | 57 | 50–65 | 39 | 31–49 | 164 | 75 | 68–83 | 51 | 42–61 |
| *Depression* | | | | | | | | | | |
| No | 2331 | 77 | 75–79 | 53 | 50–55 | 1851 | 82 | 80–84 | 61 | 58–63 |
| Yes | 39 | 87 | 77–98 | 57 | 40–79 | 45 | 83 | 71–96 | 61 | 47–81 |

**Table 4 – *continued***

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | 1-year survival | | 5-year survival | | No. | 1-year survival | | 5-year survival | |
| | | % | 95% CI | % | 95% CI | | % | 95% CI | % | 95% CI |
| *Schizophrenia or other psychosis* | | | | | | | | | | |
| No | 2344 | 77 | 76–79 | 53 | 51–55 | 1870 | 82 | 81–84 | 61 | 59–63 |
| Yes | 26 | 66 | 51–86 | 39 | 22–68 | 26 | 74 | 60–93 | 57 | 38–86 |

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 follow-up to age 69.
d Based on theory of creative class:[23] 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[16] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

by the excess mortality rate curves. The confidence intervals for the 1- and 5-year survival estimates for the educational groups overlapped, however (Table 2). There were no clear associations between survival after HL and any other socioeconomic, demographic or health-related variable included in Table 2.




| Incidence rate | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Basic school (*n* =838 ) | Vocational (*n* =792 ) | Higher (*n* =365 ) | Basic school (*n* =769 ) | Vocational (*n* =342) | Higher (*n* =196 ) |
| Crude | 19 | 15 | 14 | 14 | 8 | 7 |
| Standardised | 16 | 16 | 17 | 11 | 9 | 10 |
| Difference | 0 | 0 | 1 | 2 | 0 | 1 |

Persons with unknown level of education not included

**Fig. 5 – Age-specific incidence rates per 100,000 person-years for leukaemia by education among persons born in 1925–1973, Denmark, diagnosed in 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 5 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for leukaemia in Danish persons born 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 | 838 | 1.00 | 1.00 | 769 | 1.00 | 1.00 |
| Vocational education | 792 | 1.01 (0.91–1.11) | 1.01 (0.92–1.12) | 342 | 0.87 (0.76–0.99) | 0.87 (0.76–1.00) |
| Higher education | 365 | 1.04 (0.92–1.18) | 1.04 (0.91–1.19) | 196 | 0.90 (0.77–1.06) | 0.91 (0.77–1.08) |
| Unknown | 34 | 1.16 (0.82–1.63) | 1.16 (0.82–1.63) | 10 | 0.70 (0.38–1.31) | 0.70 (0.38–1.31) |
| *Disposable income*[c] | | | | | | |
| Lowest (1st quartile) | 656 | 1.04 (0.93–1.16) | 1.04 (0.94–1.16) | 445 | 1.03 (0.91–1.18) | 1.01 (0.89–1.16) |
| Middle (2nd–3rd quartile) | 875 | 1.00 | 1.00 | 594 | 1.00 | 1.00 |
| Highest (4th quartile) | 498 | 1.04 (0.93–1.16) | 1.03 (0.92–1.15) | 278 | 0.95 (0.82–1.10) | 0.97 (0.84–1.12) |
| *Affiliation to work market*[d] | | | | | | |
| Working | 1172 | 1.00 | 1.00 | 613 | 1.00 | 1.00 |
| Unemployed or other | 176 | 0.91 (0.78–1.07) | 0.90 (0.77–1.06) | 207 | 1.06 (0.90–1.24) | 1.05 (0.88–1.24) |
| Early retirement pensioner | 161 | 1.18 (1.00–1.39) | 1.17 (0.99–1.39) | 170 | 1.02 (0.86–1.22) | 0.99 (0.82–1.19) |
| *Social class*[e] | | | | | | |
| Creative core | 107 | 0.98 (0.80–1.21) | 0.97 (0.77–1.23) | 18 | 0.79 (0.48–1.30) | 0.89 (0.53–1.50) |
| Creative professional | 353 | 1.13 (1.00–1.29) | 1.13 (0.98–1.30) | 113 | 0.98 (0.76–1.27) | 1.08 (0.82–1.43) |
| Bohemian | 10 | 1.00 (0.53–1.86) | 0.99 (0.53–1.85) | 2 | 0.61 (0.15–2.47) | 0.66 (0.16–2.70) |
| Service | 474 | 1.03 (0.92–1.16) | 1.03 (0.92–1.16) | 704 | 0.89 (0.74–1.08) | 0.94 (0.77–1.14) |
| Manual | 776 | 1.00 | 1.00 | 122 | 1.00 | 1.00 |
| Agricultural | 113 | 0.97 (0.80–1.18) | 0.97 (0.80–1.18) | 21 | 0.69 (0.43–1.10) | 0.69 (0.43–1.09) |
| Unknown | 196 | 1.14 (0.97–1.33) | 1.14 (0.97–1.33) | 337 | 0.84 (0.68–1.04) | 0.85 (0.69–1.05) |
| *Housing tenure* | | | | | | |
| Owner-occupied | 1437 | 1.00 | 1.00 | 858 | 1.00 | 1.00 |
| Rental | 555 | 0.97 (0.88–1.07) | 0.97 (0.88–1.07) | 446 | 0.94 (0.84–1.05) | 0.93 (0.83–1.04) |
| Unknown | 37 | 1.45 (1.05–2.01) | 1.45 (1.04–2.01) | 13 | 0.94 (0.54–1.62) | 0.93 (0.54–1.60) |
| *Size of dwelling ($m^2$)* | | | | | | |
| 0–49 | 77 | 1.27 (1.00–1.60) | 1.26 (1.00–1.60) | 17 | 0.87 (0.54–1.41) | 0.86 (0.53–1.39) |
| 50–99 | 631 | 0.95 (0.86–1.06) | 0.95 (0.86–1.06) | 522 | 1.01 (0.89–1.15) | 1.00 (0.88–1.14) |
| 100–149 | 822 | 1.00 | 1.00 | 491 | 1.00 | 1.00 |
| ⩾150 | 499 | 0.95 (0.85–1.07) | 0.95 (0.85–1.06) | 287 | 1.02 (0.88–1.18) | 1.03 (0.89–1.20) |
| *Cohabiting status* | | | | | | |
| Married | 1484 | 1.00 | 1.00 | 820 | 1.00 | 1.00 |
| Cohabiting | 151 | 1.05 (0.88–1.25) | 1.05 (0.89–1.25) | 96 | 1.24 (1.00–1.53) | 1.23 (0.99–1.53) |
| Single | 164 | 0.89 (0.76–1.05) | 0.88 (0.75–1.05) | 68 | 0.93 (0.73–1.20) | 0.93 (0.72–1.20) |
| Widow or widower | 78 | 0.92 (0.73–1.16) | 0.92 (0.73–1.15) | 204 | 1.11 (0.94–1.31) | 1.10 (0.93–1.29) |
| Divorced | 152 | 0.94 (0.80–1.12) | 0.93 (0.79–1.11) | 129 | 0.99 (0.82–1.19) | 0.98 (0.81–1.19) |
| *Type of district* | | | | | | |
| Capital area | 638 | 1.00 | 1.00 | 404 | 1.00 | 1.00 |
| Provincial city | 1032 | 0.94 (0.85–1.04) | 0.94 (0.85–1.04) | 703 | 1.06 (0.93–1.19) | 1.04 (0.91–1.17) |
| Rural area | 257 | 0.96 (0.83–1.11) | 0.96 (0.83–1.11) | 142 | 0.94 (0.78–1.14) | 0.92 (0.76–1.11) |
| Peripheral rural area[f] | 102 | 0.83 (0.67–1.02) | 0.83 (0.67–1.03) | 68 | 0.98 (0.76–1.27) | 0.95 (0.73–1.23) |
| *Ethnicity*[g] | | | | | | |
| Danish | 2029 | 1.00 | 1.00 | 1317 | 1.00 | 1.00 |
| Immigrant or descendant from western country | 41 | 1.06 (0.78–1.44) | 1.01 (0.74–1.39) | 29 | 0.88 (0.61–1.27) | 0.92 (0.63–1.32) |
| Immigrant or descendant from non-western country | 43 | 0.89 (0.66–1.20) | 0.82 (0.60–1.13) | 27 | 0.91 (0.62–1.33) | 1.02 (0.68–1.54) |
| *Charlson comorbidity index*[h] | | | | | | |
| None | 1592 | 1.00 | 1.00 | 1129 | 1.00 | 1.00 |
| 1 | 278 | 1.10 (0.97–1.26) | 1.11 (0.97–1.26) | 108 | 0.89 (0.73–1.09) | 0.88 (0.72–1.08) |
| ⩾2 | 159 | 1.24 (1.05–1.47) | 1.24 (1.05–1.47) | 80 | 1.15 (0.92–1.45) | 1.14 (0.91–1.43) |
| *Depression* | | | | | | |
| No | 1990 | 1.00 | 1.00 | 1284 | 1.00 | 1.00 |
| Yes | 39 | 1.10 (0.80–1.51) | 1.10 (0.80–1.51) | 33 | 0.78 (0.55–1.11) | 0.77 (0.55–1.09) |

**Table 5 – *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 | 2010 | 1.00 | 1.00 | 1298 | 1.00 | 1.00 |
| Yes | 19 | 1.05 (0.67–1.64) | 1.05 (0.67–1.65) | 19 | 1.21 (0.77–1.91) | 1.19 (0.76–1.88) |

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:[23] 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[16] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

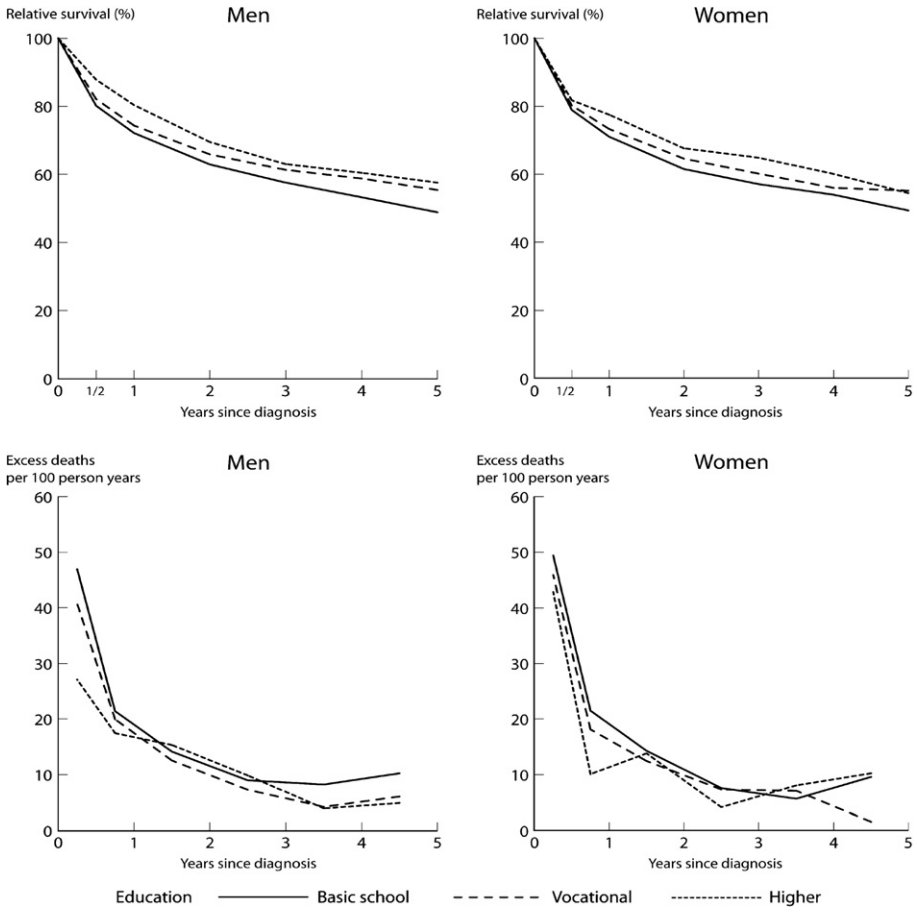



**Fig. 6 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born in 1925–1973, with leukaemia diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients and 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 leukaemia in the study cohort.**

**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 1925–1973, with leukaemia diagnosed in Denmark between 1994 and 2003 and followed through 2006**

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | 1-year survival | | 5-year survival | | No. | 1-year survival | | 5-year survival | |
| | | % | 95% CI | % | 95% CI | | % | 95% CI | % | 95% CI |
| *Level of education* | | | | | | | | | | |
| Basic or high school | 827 | 72 | 69–75 | 46 | 43–50 | 763 | 71 | 68–74 | 46 | 42–50 |
| Vocational education | 785 | 74 | 71–78 | 52 | 48–56 | 339 | 73 | 69–78 | 51 | 45–57 |
| Higher education | 359 | 80 | 76–85 | 54 | 48–60 | 191 | 78 | 71–85 | 52 | 44–61 |
| Unknown | 34 | 74 | 63–88 | 52 | 40–68 | 10 | 57 | 37–86 | 39 | 21–73 |
| *Disposable income*[b] | | | | | | | | | | |
| Lowest (1st quartile) | 645 | 72 | 68–76 | 45 | 40–50 | 439 | 73 | 68–78 | 49 | 43–55 |
| Middle (2nd–3rd quartile) | 867 | 74 | 71–77 | 48 | 45–52 | 588 | 69 | 65–73 | 44 | 40–48 |
| Highest (4th quartile) | 493 | 78 | 74–83 | 56 | 51–62 | 276 | 79 | 73–85 | 57 | 50–65 |
| *Affiliation to work market*[c] | | | | | | | | | | |
| Working | 1162 | 81 | 79–83 | 58 | 55–61 | 608 | 81 | 78–84 | 58 | 54–62 |
| Unemployed or other | 173 | 86 | 80–93 | 64 | 55–74 | 207 | 72 | 66–80 | 52 | 44–61 |
| Early retirement pensioner | 158 | 72 | 63–83 | 44 | 33–58 | 168 | 64 | 56–75 | 43 | 33–56 |
| *Social class*[d] | | | | | | | | | | |
| Creative core | 104 | 80 | 73–89 | 52 | 42–63 | 18 | 54 | 33–88 | 44 | 23–84 |
| Creative professional | 350 | 75 | 70–80 | 50 | 44–56 | 112 | 80 | 73–89 | 49 | 40–61 |
| Bohemian | 10 | 101 | – | 65 | 51–82 | 2 | 51 | 22–118 | 54 | 23–126 |
| Service | 465 | 75 | 71–79 | 53 | 48–58 | 695 | 73 | 70–77 | 49 | 45–53 |
| Manual | 770 | 72 | 69–75 | 47 | 44–51 | 121 | 79 | 72–86 | 53 | 44–64 |
| Agricultural | 112 | 78 | 70–86 | 52 | 42–63 | 21 | 73 | 58–92 | 47 | 31–70 |
| Unknown | 194 | 69 | 62–76 | 41 | 33–50 | 334 | 63 | 58–69 | 39 | 33–45 |
| *Housing tenure* | | | | | | | | | | |
| Owner-occupied | 1428 | 76 | 73–78 | 51 | 49–54 | 851 | 74 | 71–77 | 49 | 46–53 |
| Rental | 540 | 71 | 67–75 | 44 | 39–49 | 439 | 69 | 65–73 | 45 | 40–50 |
| Unknown | 37 | 67 | 53–84 | 47 | 32–69 | 13 | 61 | 39–95 | 50 | 32–77 |
| *Size of dwelling ($m^2$)* | | | | | | | | | | |
| 0–49 | 75 | 69 | 58–81 | 34 | 23–49 | 17 | 85 | 72–99 | 69 | 48–98 |
| 50–99 | 615 | 71 | 68–75 | 45 | 41–50 | 515 | 69 | 65–73 | 44 | 39–48 |
| 100–149 | 818 | 75 | 72–78 | 51 | 48–55 | 485 | 74 | 71–78 | 52 | 48–57 |
| ⩾150 | 497 | 76 | 72–80 | 52 | 48–57 | 286 | 75 | 70–81 | 47 | 41–53 |
| *Cohabiting status* | | | | | | | | | | |
| Married | 1467 | 75 | 73–77 | 52 | 49–55 | 815 | 73 | 70–76 | 49 | 45–52 |
| Cohabiting | 149 | 74 | 66–83 | 37 | 28–48 | 96 | 76 | 67–87 | 55 | 44–70 |
| Single | 162 | 67 | 59–75 | 39 | 31–49 | 66 | 64 | 52–78 | 43 | 30–60 |
| Widow/widower | 77 | 71 | 58–86 | 45 | 32–63 | 198 | 59 | 52–66 | 38 | 31–47 |
| Divorced | 150 | 72 | 65–81 | 49 | 40–61 | 128 | 70 | 62–78 | 48 | 40–58 |
| *Type of district* | | | | | | | | | | |
| Capital area | 627 | 76 | 73–80 | 52 | 48–56 | 396 | 77 | 73–82 | 55 | 50–60 |
| Provincial city | 1021 | 75 | 72–78 | 50 | 47–53 | 699 | 71 | 67–74 | 43 | 39–47 |
| Rural area | 256 | 71 | 66–77 | 47 | 41–54 | 140 | 71 | 63–79 | 52 | 44–62 |
| Peripheral rural area[e] | 101 | 64 | 55–74 | 34 | 25–47 | 68 | 66 | 55–79 | 43 | 32–58 |
| *Ethnicity*[f] | | | | | | | | | | |
| Danish | 2005 | 74 | 72–76 | 49 | 47–52 | 1303 | 72 | 70–75 | 48 | 45–51 |
| Immigrant or descendant from western country | 40 | 84 | 73–97 | 62 | 47–82 | 28 | 74 | 59–92 | 51 | 34–78 |
| Immigrant or descendant from non-western country | 42 | 69 | 55–86 | 45 | 32–65 | 27 | 72 | 57–91 | 37 | 22–63 |
| *Charlson comorbidity index*[g] | | | | | | | | | | |
| None | 1577 | 76 | 73–78 | 51 | 49–54 | 1116 | 74 | 71–76 | 49 | 46–52 |
| 1 | 274 | 72 | 66–78 | 47 | 40–55 | 108 | 66 | 57–77 | 40 | 30–53 |
| ⩾2 | 154 | 61 | 52–72 | 34 | 25–47 | 79 | 69 | 60–80 | 38 | 26–56 |
| *Depression* | | | | | | | | | | |
| No | 1966 | 74 | 72–76 | 49 | 47–52 | 1270 | 73 | 70–75 | 48 | 45–51 |
| Yes | 39 | 80 | 68–93 | 49 | 35–67 | 33 | 53 | 38–74 | 41 | 26–65 |

**Table 6 – *continued***

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | 1-year survival | | 5-year survival | | No. | 1-year survival | | 5-year survival | |
| | | % | 95% CI | % | 95% CI | | % | 95% CI | % | 95% CI |
| *Schizophrenia or other psychosis* | | | | | | | | | | |
| No | 1988 | 74 | 72–76 | 49 | 47–52 | 1284 | 73 | 70–75 | 48 | 45–51 |
| Yes | 17 | 45 | 28–71 | 36 | 19–69 | 19 | 46 | 27–78 | 38 | 20–74 |

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 follow-up to age 69.
d Based on theory of creative class:[23] 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[16] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

### 3.2. *Non-Hodgkin lymphoma*

NHL was diagnosed in 4516 persons in the cohort during the study period, constituting 60% of all cases of NHL diagnosed in Denmark in that period.[1] Amongst Danish persons, the male:female ratio was 1.26, and the age- and period-standardised incidence rates were 19 per 100,000 person-years for men and 15 per 100,000 person-years for women. The 1-year relative survival was 77% for men and 82% for women, and the relative survival 5 years after diagnosis was 53% for men and 61% for women.

The age- and period-standardised incidence rates of NHL did not differ by educational level for either men or women (Fig. 3). No general association was found between indicators of socioeconomic position and incidence of NHL, but the adjusted IRRs for NHL tended to be higher amongst early retirement pensioners than those working and amongst those renting their housing compared with those owning their housing (Table 3). Living in capital areas was associated with the highest IRR. A clear increase in IRR by increasing Charlson comorbidity score was observed. All the described associations were seen in both sexes.

In both men and women, relative survival after NHL was similar in those with vocational and those with higher education, whereas poorer survival was seen amongst those with only basic schooling (Fig. 4). The excess mortality curves indicate that the difference in survival is due mainly to differences in excess mortality rates within the first year after diagnosis of NHL (Fig. 4). Survival was markedly higher for women than men, but the associations between indicators of socioeconomic position and survival after NHL were similar for both sexes (Table 4). The 5-year relative survival estimates were lower for people with the shortest education than those with longer education, for those with the least disposable income compared to those with highest income, for those who were unemployed and early retirement pensioners compared to those working and for those renting their housing compared to those owning housing, with no overlap in the confidence intervals for survival estimates amongst men for these findings. The survival of both men and women increased with increasing size of dwelling. Survival was poorer amongst single and widowed persons and amongst persons with a Charlson comorbidity score of $\geqslant 2$, particular amongst men.

### 3.3. *Leukaemia*

Leukaemia was diagnosed in 3486 persons (1249 with acute leukaemia and 2237 with other leukaemia) in the cohort during the study period, constituting 48% of all cases of leukaemia diagnosed in Denmark in that period. Amongst Danish persons, the male:female ratio was 1.54, and the age- and period-standardised incidence rate was 16 per 100,000 person-years for men and 10 per 100,000 person-years for women. The 1-year relative survival was 74% for men and 72% for women, and the relative survival 5 years after diagnosis was 49% for men and 48% for women. These numbers conceal considerable differences in survival from the two types of leukaemia: For patients with acute leukaemia, the 1-year relative survival was 45% for both sexes, whereas survival from other leukaemia was 88% for men and 92% for women. The relative survival 5 years after diagnosis was 19% for both men and women with acute leukaemia, and 65% for men and 71% for women with other leukaemia.

The age- and period-standardised incidence rates of leukaemia were approximately the same in all educational groups for both men and women (Fig. 5). There was no general pattern of association between indicators of socioeconomic position and incidence of leukaemia in either sex, but a few sex-specific associations were observed (Table 5). Male early retirement pensioners (compared to males working), men with unknown housing tenure (compared to owner-occupied housing) and men living in the smallest housing (compared to men living in larger housing) had

significantly or borderline significantly increased adjusted IRRs, whereas women with vocational education (compared to women with basic schooling) had a borderline significantly lower adjusted IRR. A Charlson comorbidity score ⩾2 compared to no score was associated with an increased IRR in both sexes, but was statistically significant only for men. The findings were similar for acute leukaemia and other leukaemia separately, although the only association that was statistically significant was that between Charlson comorbidity index and acute leukaemia amongst men (data not shown).

The age-standardised relative survival curves for men and women with leukaemia showed slightly worse survival for those in the lowest educational group than for the other two groups (Fig. 6). For men, the excess mortality rates differed mainly during the first year after diagnosis (Fig. 6). Table 6 shows that the confidence intervals for the different educational groups for both 1- and 5-year relative survival overlapped for both sexes. In general, there appeared to be some tendency towards worse survival for both men and women of low socioeconomic position, such as early retirement pensioners compared to those working and those renting their housing compared to those owning their housing. The 5-year relative survival decreased with increasing Charlson comorbidity index score. When the two types of leukaemia were considered separately, similar tendencies as described above were seen for both subtypes (data not shown).

## 4. Discussion

We found no clear overall association between socioeconomic or demographic indicators and the incidence of any of the three haematological cancers, and most of our findings for specific variables were not consistent for men and women. The lack of any major effect of socioeconomic position on the incidence of NHL or leukaemia is in agreement with the overall evidence from previous studies.[4–7] These studies, however, provided no detailed analyses of socioeconomic position, and NHL and leukaemia were included in analyses searching for associations with cancers at a broad range of sites. Although higher socioeconomic position has been associated with a higher incidence of HL, this association appears to be relevant mainly for young adults aged 15–44 years, and some earlier studies addressed childhood socioeconomic position or indicators of childhood socioeconomic position instead of adult socioeconomic position.[8–10]

The most consistent finding for the incidence of all three types of haematological cancer was a positive association with the Charlson comorbidity index. The association with a comorbidity score of 1 for NHL might be due to the relation between some autoimmune diseases (included in the score 1 category under 'connective tissue diseases') and NHL.[18] The even more pronounced association with scores ⩾2 might be due partly to the fact that NHL is considered an 'AIDS-defining condition',[19] AIDS having a comorbidity score of 6. The incidences of HL and leukaemia were also increased amongst persons with comorbidity scores ⩾2. At least for HL, the underlying explanation might be similar to that for NHL, because although HL is not an AIDS-defining condition the risk for this cancer is very high amongst HIV-infected persons.[19]

We found some evidence of social inequality in survival from NHL, most of the indicators of low socioeconomic position, e.g. shortest education and lowest disposable income, being associated with poorer survival. The differences in survival were most pronounced amongst men, who also had a lower survival rate than women overall for almost all categories investigated. There are, to our knowledge, no published studies on the relation between socioeconomic position and survival after NHL, but the finding of better survival of women than men is consistent with a previous finding based on data from Europe and the United States.[20] Smoking and alcohol consumption have been associated with a poorer prognosis for NHL,[21] and, as smoking is more prevalent in groups of low socioeconomic position in Denmark,[22] this might be one explanation for the observed differences in survival by socioeconomic position. As the excess mortality rate differed by educational level mainly within the first year after diagnosis, however, delayed diagnosis amongst persons of lower socioeconomic position might be the most important explanation.

No statistically significant associations between indicators of socioeconomic position and survival after HL or leukaemia were seen in our study, although the findings for leukaemia were in the same direction as those for NHL, with poorer survival of persons of the lowest socioeconomic position.

Few previous studies have addressed the relationship between socioeconomic position and survival from haematological cancers. In a cancer registry study in Turin, Italy, a lower case fatality rate was found for all haematological neoplasms grouped together for persons with the highest educational level.[12] Another study found no significant association between socioeconomic position and survival from acute myeloid leukaemia.[13] A study in Brazil showed better 2-year overall survival after HL amongst persons of higher socioeconomic position,[14] although this finding is in contrast to that of a study in Austria, which showed that relapse-free survival rates increased with decreasing educational level and decreasing average income per month amongst patients with HL.[15]

Comorbidity was associated with poorer survival amongst patients with NHL and leukaemia; in particular, men with a Charlson comorbidity index ⩾ 2 had markedly poor survival. This finding is not surprising, as these patients have other serious illnesses. No similar picture was seen for HL; however, few HL patients had the diseases defined in comorbidity scores 1 and ⩾ 2.

In general, the rarity of HL limits the possibility of detecting statistically significant associations with the variables addressed in this study. Although NHL and leukaemia are commoner, low statistical power is also an issue, especially for identifying associations with infrequent subcategories of the variables. The three types of haematological cancer considered here each consists of several subtypes with known differences in epidemiological and prognostic characteristics. This is particularly the case for leukaemia. We analysed the incidence of and survival from acute leukaemia and other leukaemia separately, although for simplicity the results by subtype are only commented upon in the text and not included in the tables or figures.

In this study, based on nationwide registry data from Denmark, we found no evidence of strong associations between

socioeconomic position and the incidence of HL, NHL or leukaemia, but comorbidity was related to incidence of all three types of haematological cancer. We found some indication of poorer survival of patients with the lowest socioeconomic position with NHL and of both NHL and leukaemia patients suffering from other serious illnesses.

## Conflict of interest statement

None declared.

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