# Social inequality and incidence of and survival from malignant melanoma in a population-based study in Denmark, 1994–2003

*Fatima Birch-Johansen[a],\*, Gitte Hvilsom[a], Trille Kjær[a], Hans Storm[b]*

[a]*Institute of Cancer Epidemiology, Danish Cancer Society, Strandboulevarden 49, DK-2100 Copenhagen Ø, Denmark*
[b]*Department of Cancer Prevention and Documentation, Danish Cancer Society, Strandboulevarden 49, DK-2100 Copenhagen Ø, Denmark*

## ARTICLE INFO

## ABSTRACT

The incidence of cutaneous malignant melanoma has increased more than that of any other cancer in most white populations during the past few decades. We investigated the effects of socioeconomic, demographic and health-related indicators on the incidence of and survival from malignant melanoma in 1994–2003 in Denmark using information from nationwide registries. The analyses were based on data on 6914 patients with malignant melanoma in a cohort of 3.22 million persons born between 1925 and 1973 and aged ⩾30 years. The age- and period-standardised incidence rate was 25 and 29 per 100,000 person-years for men and women, respectively. We found an increased risk for malignant melanoma in the highest socioeconomic groups. In general, survival after a malignant melanoma was better in high socioeconomic groups and better in women than men. Our results support earlier reports that malignant melanoma is associated with higher socioeconomic position.

## 1. Introduction

The incidence of malignant melanoma of the skin (melanoma) has increased more than that of any other cancer in most white populations during the past three decades.[1] In Europe, the incidence rates of melanoma follow a North–South gradient, with the highest rates in northern parts of Europe.[2] Earlier reports showed a marked increase in melanoma incidence in Denmark,[3] with a 25-fold increase in men and a 35-fold increase in women during the past 60 years.[4] During our study period, the number of melanoma cases increased from 932 in 1994 to 1227 in 2003. Melanoma is the sixth commonest cancer in Danish men and the fifth in women. Despite the marked increase in incidence rate, the mortality rate has remained relatively low and stable, between 1.5 and 2 per 100,000 for women,

and 2.3 and 2.8 per 100,000 for men in the period 1974–2003.[4]

The most important risk factor for melanoma is exposure to ultraviolet radiation, and the most prevalent predictor of melanoma is excessive exposure, especially intermittent, to the sun in childhood, recalled as sunburn. Cumulative long-term exposure to the sun, photosensitive skin type and having atypical naevi, large number of naevi and a family history of skin cancer are other known risk factors.[3,5] Reports from the 1980s showed consistently that melanoma is associated with higher socioeconomic position,[2,5] even with confounding from exposure to sunlight in outdoor occupations and host factors such as skin, eye and hair colour, and recreational exposure to the sun.[6]

To our knowledge, this is the first nationwide registry-based study of the role of socioeconomic position and

**Table 1 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for malignant melanoma 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 | 939 | 1.00 | 1.00 | 1387 | 1.00 | 1.00 |
| Vocational education | 1312 | 1.29 (1.18–1.40) | 1.24 (1.14–1.35) | 1294 | 1.39 (1.29–1.51) | 1.34 (1.24–1.45) |
| Higher education | 815 | 1.72 (1.57–1.89) | 1.53 (1.38–1.69) | 927 | 1.56 (1.43–1.70) | 1.44 (1.32–1.58) |
| Unknown | 50 | 1.34 (1.01–1.78) | 1.32 (0.99–1.75) | 33 | 1.05 (0.75–1.49) | 1.04 (0.74–1.47) |
| *Disposable income[c]* | | | | | | |
| Lowest (1st quartile) | 645 | 0.84 (0.76–0.93) | 0.88 (0.80–0.97) | 788 | 0.91 (0.83–0.99) | 0.96 (0.88–1.05) |
| Middle (2nd–3rd quartile) | 1389 | 1.00 | 1.00 | 1677 | 1.00 | 1.00 |
| Highest (4th quartile) | 1082 | 1.41 (1.30–1.53) | 1.30 (1.20–1.41) | 1176 | 1.37 (1.27–1.47) | 1.28 (1.19–1.39) |
| *Affiliation to work market[d]* | | | | | | |
| Working | 2336 | 1.00 | 1.00 | 2560 | 1.00 | 1.00 |
| Unemployed or other | 262 | 0.80 (0.70–0.91) | 0.91 (0.79–1.03) | 455 | 0.74 (0.67–0.82) | 0.82 (0.74–0.91) |
| Early retirement pensioner | 108 | 0.50 (0.41–0.60) | 0.60 (0.49–0.73) | 233 | 0.57 (0.49–0.65) | 0.67 (0.58–0.77) |
| *Social class[e]* | | | | | | |
| Creative core | 267 | 1.78 (1.55-2.04) | 1.38 (1.18-1.62) | 99 | 1.60 (1.26-2.03) | 1.16 (0.90-1.48) |
| Creative professional | 670 | 1.68 (1.52-1.85) | 1.43 (1.28-1.59) | 417 | 1.67 (1.42-1.97) | 1.29 (1.08-1.53) |
| Bohemian | 18 | 1.34 (0.84-2.13) | 1.14 (0.71-1.83) | 13 | 1.66 (0.95-2.90) | 1.29 (0.73-2.26) |
| Service | 847 | 1.41 (1.29–1.55) | 1.33 (1.21–1.46) | 2282 | 1.44 (1.26–1.65) | 1.27 (1.10–1.46) |
| Manual | 972 | 1.00 | 1.00 | 227 | 1.00 | 1.00 |
| Agricultural | 123 | 0.96 (0.79–1.16) | 1.01 (0.84–.22) | 59 | 1.34 (1.00–1.78) | 1.31 (0.99–1.75) |
| Unknown | 219 | 1.15 (0.99–1.33) | 1.18 (1.02–1.37) | 544 | 1.10 (0.94–1.29) | 1.08 (0.92–1.26) |
| *Housing tenure* | | | | | | |
| Owner-occupied | 2324 | 1.00 | 1.00 | 2580 | 1.00 | 1.00 |
| Rental | 749 | 0.83 (0.76–0.90) | 0.88 (0.81–0.96) | 1021 | 0.81 (0.75–0.87) | 0.85 (0.79–0.92) |
| Unknown | 43 | 0.90 (0.66–1.22) | 0.98 (0.72–1.32) | 40 | 0.86 (0.63–1.18) | 0.90 (0.66–1.23) |
| *Size of dwelling (m²)* | | | | | | |
| 0–49 | 64 | 0.60 (0.46–0.77) | 0.68 (0.52–0.87) | 44 | 0.71 (0.53–0.96) | 0.75 (0.56–1.02) |
| 50–99 | 825 | 0.84 (0.77–0.91) | 0.89 (0.81–0.97) | 1082 | 0.82 (0.76–0.89) | 0.86 (0.79–0.93) |
| 100–149 | 1291 | 1.00 | 1.00 | 1485 | 1.00 | 1.00 |
| ⩾150 | 936 | 1.11 (1.02–1.21) | 1.04 (0.96–1.14) | 1030 | 1.15 (1.06–1.24) | 1.09 (1.00–1.18) |
| *Cohabiting status* | | | | | | |
| Married | 2301 | 1.00 | 1.00 | 2519 | 1.00 | 1.00 |
| Cohabiting | 266 | 0.82 (0.72–0.94) | 0.84 (0.73–0.96) | 312 | 0.80 (0.71–0.91) | 0.80 (0.71–0.91) |
| Single | 281 | 0.72 (0.63–0.81) | 0.80 (0.70–0.91) | 269 | 0.85 (0.75–0.97) | 0.89 (0.78–1.01) |
| Widow or widower | 77 | 0.92 (0.73–1.16) | 0.97 (0.77–1.22) | 254 | 0.88 (0.77–1.01) | 0.93 (0.81–1.07) |
| Divorced | 191 | 0.74 (0.64–0.86) | 0.82 (0.70–0.95) | 287 | 0.78 (0.69–0.88) | 0.84 (0.74–0.95) |
| *Type of district* | | | | | | |
| Capital area | 1051 | 1.00 | 1.00 | 1131 | 1.00 | 1.00 |
| Provincial city | 1589 | 0.89 (0.83–0.97) | 0.96 (0.89–1.04) | 1961 | 1.07 (0.99–1.15) | 1.14 (1.06–1.23) |
| Rural area | 319 | 0.74 (0.65–0.84) | 0.83 (0.73–0.94) | 383 | 0.92 (0.82–1.03) | 1.01 (0.89–1.13) |
| Peripheral rural area[f] | 157 | 0.83 (0.70–0.98) | 0.95 (0.80–1.12) | 166 | 0.92 (0.78–1.08) | 1.03 (0.87–1.21) |
| *Ethnicity[g]* | | | | | | |
| Danish | 3116 | 1.00 | 1.00 | 3641 | 1.00 | 1.00 |
| Immigrant or descendant from western country | 70 | 1.07 (0.84–1.35) | 1.00 (0.79–1.27) | 87 | 1.01 (0.81–1.24) | 0.97 (0.78–.20) |
| Immigrant or descendant from non–western country | 22 | 0.23 (0.15–0.35) | 0.26 (0.17–0.39) | 24 | 0.21 (0.14–0.31) | 0.23 (0.16–0.35) |
| *Charlson comorbidity index[h]* | | | | | | |
| None | 2710 | 1.00 | 1.00 | 3339 | 1.00 | 1.00 |
| 1 | 274 | 0.86 (0.75–0.97) | 0.90 (0.79–1.02) | 191 | 0.77 (0.67–0.89) | 0.81 (0.70–0.94) |
| ⩾2 | 132 | 0.87 (0.73–1.04) | 0.92 (0.77–1.10) | 111 | 0.83 (0.68–1.00) | 0.87 (0.72–1.05) |
| *Depression* | | | | | | |
| No | 3070 | 1.00 | 1.00 | 3558 | 1.00 | 1.00 |
| Yes | 46 | 0.95 (0.71–1.27) | 1.01 (0.75–1.35) | 83 | 0.90 (0.73–.12) | 0.95 (0.76–.18) |
| *Schizophrenia or other psychosis* | | | | | | |
| No | 3092 | 1.00 | 1.00 | 3610 | 1.00 | 1.00 |
| Yes | 24 | 0.75 (0.50–1.12) | 0.86 (0.58–1.29) | 31 | 0.74 (0.52–1.05) | 0.81 (0.57–1.16) |

a  Adjusted for calendar period (in 5-year intervals) and age modelled as age and age² 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[14]: the creative core (e.g. researchers, designers and architects), creative professionals (e.g. managers, business and finance, lawyers and doctors), bohemians (e.g. artists and models), the service class (e.g. nurses, hairdressers and caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers and 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[7] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

demographic factors in the incidence of and survival from melanoma in Denmark. It was carried out as part of a comprehensive, rigorous analysis of the role of socioeconomic position in cancer incidence and survival.
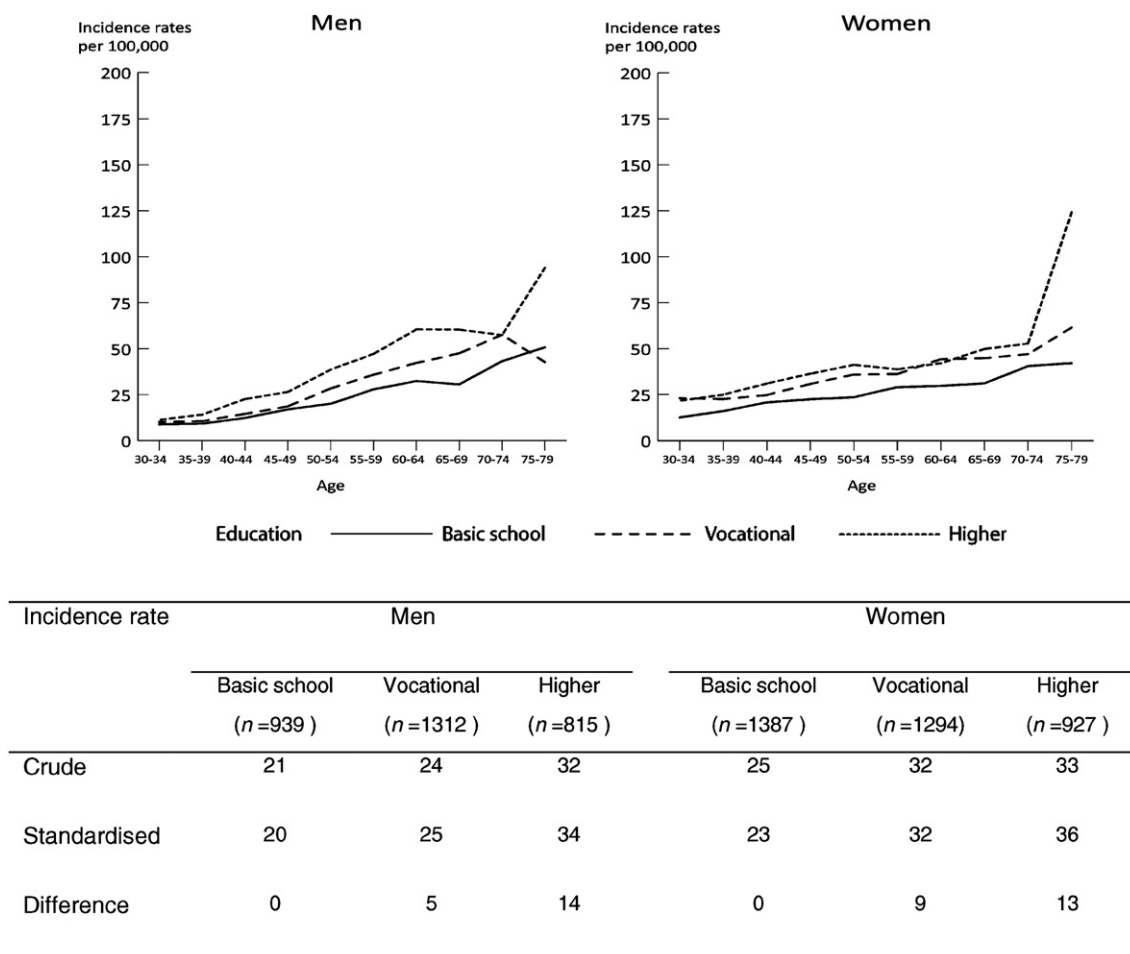
## 2. Material and methods

The material and methods are described elsewhere.[7] 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 [7]) Information on socioeconomic, demographic and health-related indicators was obtained from various Danish registers based on administrative data.[7] Crude, age-specific and age-standardised incidence rates are presented for melanoma (ICD-10 C43) 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.[8] 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.[7] 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.[7]

## 3. Results

We included 6914 persons aged 30–70 years in whom melanoma was diagnosed in 1994–2003, comprising 70% of all melanomas diagnosed in Denmark in the same period.[4] Amongst Danish persons, the female:male ratio was 1.18, and the age- and period-standardised incidence rate in the cohort was 29 per 100,000 person-years for women and 25 per 100,000 person-years for men.



| Incidence rate | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Basic school | Vocational | Higher | Basic school | Vocational | Higher |
| | (n =939 ) | (n =1312 ) | (n =815 ) | (n =1387 ) | (n =1294) | (n =927 ) |
| Crude | 21 | 24 | 32 | 25 | 32 | 33 |
| Standardised | 20 | 25 | 34 | 23 | 32 | 36 |
| Difference | 0 | 5 | 14 | 0 | 9 | 13 |

Persons with unknown level of education not included

Fig. 1 – Age-specific incidence rates per 100,000 person-years for malignant melanoma by education amongst 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. Persons with the unknown level of education not included.

**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 between 1925 and 1973, with malignant melanoma diagnosed in Denmark between 1994 and 2003, and followed through 2006**

| | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | 1-year survival | | 5-year survival | | Number | 1-year survival | | 5-year survival | |
| | | % | 95% CI | % | 95% CI | | % | 95% CI | % | 95% CI |
| *Level of education* | | | | | | | | | | |
| Basic or high school | 939 | 93 | 91–95 | 75 | 72–78 | 1386 | 97 | 96–98 | 86 | 84–88 |
| Vocational education | 1312 | 95 | 94–96 | 80 | 78–83 | 1293 | 97 | 96–98 | 89 | 87–92 |
| Higher education | 815 | 97 | 96–98 | 81 | 78–84 | 927 | 98 | 97–99 | 92 | 89–94 |
| Unknown | 50 | 98 | 95–102 | 91 | 79–104 | 33 | 96 | 88–105 | 86 | 75–99 |
| *Disposable income[b]* | | | | | | | | | | |
| Lowest (1st quartile) | 645 | 91 | 89–94 | 73 | 69–78 | 788 | 97 | 95–98 | 87 | 84–90 |
| Middle (2nd–3rd quartile) | 1389 | 95 | 94–97 | 79 | 77–82 | 1675 | 97 | 96–98 | 88 | 86–90 |
| Highest (4th quartile) | 1082 | 96 | 95–98 | 82 | 79–85 | 1176 | 98 | 98–99 | 92 | 90–94 |
| *Affiliation to work market[c]* | | | | | | | | | | |
| Working | 2336 | 97 | 96–98 | 84 | 82–86 | 2559 | 98 | 98–99 | 92 | 90–93 |
| Unemployed or other | 262 | 91 | 86–95 | 80 | 74–87 | 454 | 99 | 97–100 | 91 | 88–94 |
| Early retirement pensioner | 108 | 97 | 93–101 | 78 | 68–91 | 233 | 95 | 92–98 | 93 | 87–99 |
| *Social class[d]* | | | | | | | | | | |
| Creative core | 267 | 95 | 93–98 | 85 | 80–90 | 99 | 95 | 89–101 | 90 | 81–99 |
| Creative professional | 670 | 95 | 93–97 | 79 | 75–82 | 417 | 99 | 98–100 | 91 | 88–95 |
| Bohemian | 18 | 92 | 81–103 | 93 | 81–106 | 13 | 61 | – | 43 | 34–55 |
| Service | 848 | 94 | 92–96 | 78 | 75–81 | 2280 | 98 | 97–99 | 90 | 89–92 |
| Manual | 971 | 95 | 94–97 | 79 | 76–81 | 227 | 97 | 95–100 | 83 | 78–89 |
| Agricultural | 123 | 94 | 90–97 | 75 | 67–83 | 59 | 97 | 92–103 | 90 | 82–100 |
| Unknown | 219 | 95 | 92–98 | 80 | 73–87 | 544 | 96 | 94–98 | 84 | 81–88 |
| *Housing tenure* | | | | | | | | | | |
| Owner-occupied | 2324 | 95 | 94–96 | 80 | 78–82 | 2578 | 98 | 97–98 | 89 | 88–91 |
| Rental | 749 | 94 | 92–96 | 77 | 73–80 | 1021 | 97 | 96–98 | 88 | 85–90 |
| Unknown | 43 | 97 | 91–103 | 72 | 57–91 | 40 | 96 | 89–103 | 87 | 75–102 |
| *Size of dwelling (m$^2$)* | | | | | | | | | | |
| 0–49 | 64 | 91 | 84–98 | 67 | 53–83 | 44 | 99 | 93–104 | 94 | 83–105 |
| 50–99 | 824 | 95 | 93–97 | 79 | 76–82 | 1082 | 96 | 95–98 | 87 | 85–90 |
| 100–149 | 1291 | 95 | 94–96 | 79 | 76–81 | 1483 | 98 | 98–99 | 89 | 88–91 |
| ⩾150 | 937 | 95 | 94–96 | 81 | 78–83 | 1030 | 97 | 96–99 | 90 | 88–92 |
| *Cohabiting status* | | | | | | | | | | |
| Married | 2301 | 95 | 95–96 | 80 | 79–82 | 2517 | 98 | 97-99 | 90 | 88–91 |
| Cohabiting | 266 | 93 | 89–98 | 77 | 70–84 | 312 | 98 | 95–100 | 91 | 87–96 |
| Single | 281 | 92 | 88–96 | 71 | 65–79 | 269 | 95 | 92–99 | 85 | 78–91 |
| Widow/widower | 77 | 97 | 92–103 | 75 | 64–87 | 254 | 97 | 95–99 | 85 | 76–95 |
| Divorced | 191 | 92 | 89–96 | 77 | 70–84 | 287 | 96 | 94–99 | 89 | 85–94 |
| *Type of district* | | | | | | | | | | |
| Capital area | 1050 | 96 | 95–97 | 82 | 79–84 | 1130 | 97 | 96–98 | 89 | 87–91 |
| Provincial city | 1590 | 94 | 93–95 | 78 | 76–80 | 1960 | 98 | 97–98 | 89 | 87–90 |
| Rural area | 319 | 94 | 91–97 | 75 | 70–81 | 383 | 98 | 97–100 | 88 | 84–92 |
| Peripheral rural area[e] | 157 | 93 | 89–98 | 81 | 74–88 | 166 | 100 | 99–101 | 92 | 87–97 |
| *Ethnicity[f]* | | | | | | | | | | |
| Danish | 3116 | 95 | 94–96 | 79 | 78–81 | 3639 | 98 | 97–98 | 89 | 88–90 |
| Immigrant or descendant from western country | 70 | 99 | 96–102 | 82 | 72–93 | 87 | 99 | 97–101 | 93 | 87–99 |
| Immigrant or descendant from non-western country | 22 | 101 | – | 80 | 61–104 | 24 | 89 | 77–102 | 89 | 76–104 |
| *Charlson comorbidity index[g]* | | | | | | | | | | |
| None | 2710 | 95 | 94–96 | 79 | 78–81 | 3337 | 98 | 97–98 | 89 | 88–90 |
| 1 | 274 | 94 | 91–98 | 82 | 76–89 | 191 | 98 | 96–100 | 84 | 78–91 |
| ⩾2 | 132 | 85 | 76–96 | 58 | 45–74 | 111 | 96 | 92–101 | 88 | 80–97 |
| *Depression* | | | | | | | | | | |
| No | 3070 | 95 | 94–96 | 79 | 78–81 | 3556 | 98 | 97–98 | 89 | 88–90 |
| Yes | 46 | 97 | 92–103 | 66 | 50–87 | 83 | 97 | 93–101 | 85 | 76–95 |
| *Schizophrenia or other psychosis* | | | | | | | | | | |
| No | 3092 | 95 | 94–96 | 79 | 78–81 | 3608 | 98 | 97–98 | 89 | 88–90 |
| Yes | 24 | 100 | 95–105 | 84 | 67–106 | 31 | 98 | 92–105 | 70 | 54–91 |

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 the number of persons in household; categorised by the 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 the theory of creative class[14]: the creative core (e.g. researchers, designers and architects), creative professionals (e.g. managers, business and finance, lawyers and doctors), bohemians (e.g. artists and models), the service class (e.g. nurses, hairdressers and caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers and 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[7] between 1978 and 2 years before the diagnosis of cancer. Grouped according to the accumulated sum of scores.

### 3.1. Incidence of malignant melanoma

High socioeconomic position was significantly associated with higher incidences of melanoma in both sexes (Table 1). We found increasing age- and period-standardised incidence rates of melanoma with the increasing level of education, the incidence rate difference between persons with basic schooling and higher education being 14 per 100,000 for men and 13 per 100,000 for women (Fig. 1).

The IRRs of socioeconomic and demographic variables adjusted for age, period, education and income increased generally with the increasing socioeconomic position in both sexes. Higher education, high disposable income, being active on the work market, occupations in the creative core, being a creative professional or service and being the owner of housing were significantly associated with high IRRs for melanoma.

Being married rather than single or divorced and living in the capital rather than rural areas for men and being married rather than divorced for women were also significantly associated with high IRRs.

### 3.2. Relative survival and excess mortality rate after melanoma

The 1-year relative survival in our cohort was 95% for men and 98% for women, and the 5-year relative survival was 79% for men and 89% for women. In general, the 1- and 5-year relative survival was lower for men than women. The overall relative 1- and 5-year survival was lower for men of low socioeconomic position than those of high socioeconomic position, and women of high socioeconomic position had slightly better relative 1- and 5-year survival than the women
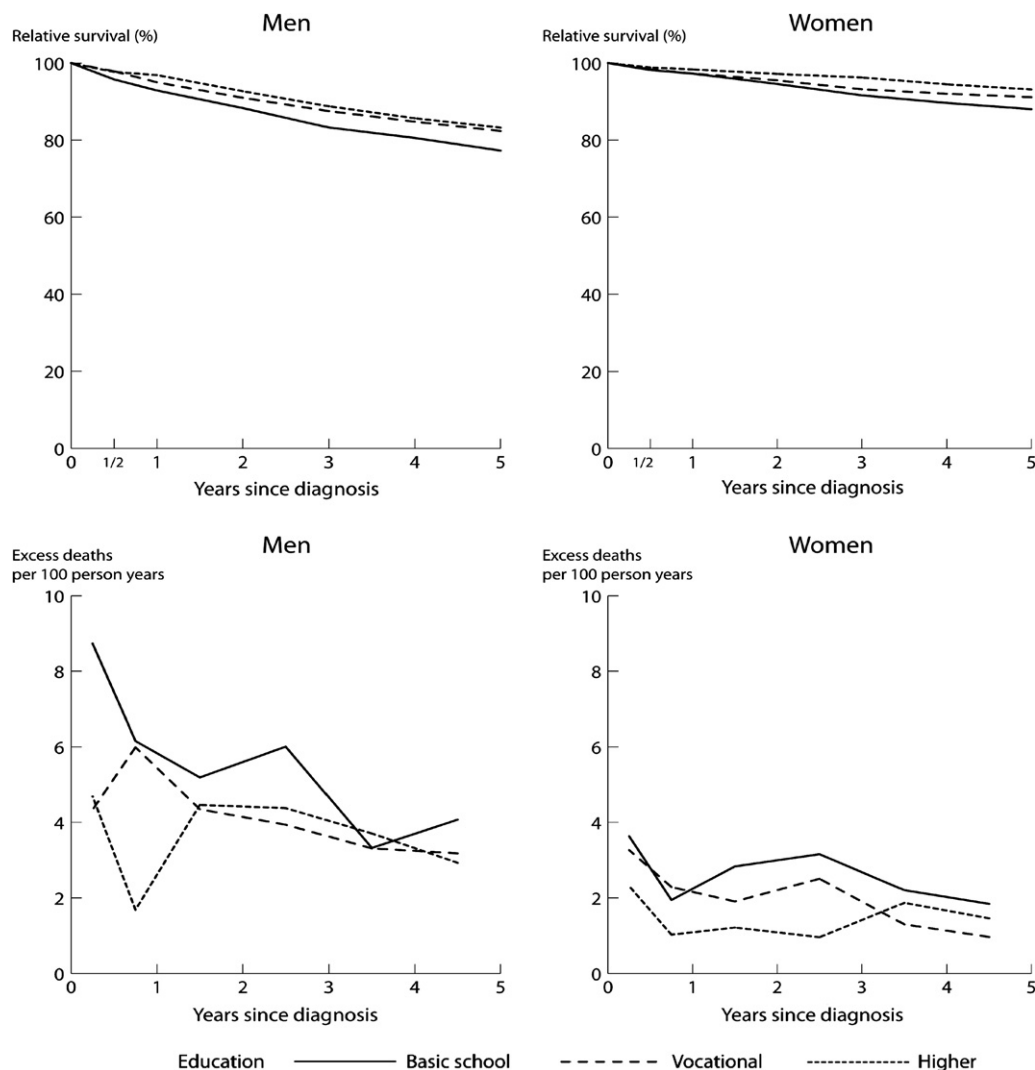


Fig. 2 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born between 1925 and 1973, with malignant melanoma diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer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

of low socioeconomic position. The survival estimates for women with a 'bohemian' occupation deviated from the general pattern, but the finding was based on small numbers (Table 2).

Fig. 2 shows the age-standardised relative survival of patients with melanoma according to educational level. Survival was generally better the higher the education was and, again, it was better for women than for men. Fig. 2 shows that excess mortality rate differed between men and women, although patients with higher education generally had the lowest excess mortality. The excess mortality rate amongst women was much lower than that amongst men, but the numbers were small. In men, the differences by educational group were more consistent during the follow-up period, the high excess mortality amongst men with basic schooling levelling of to become similar to that of men with vocational or higher education after 3 years.

## 4.    Discussion

Our study showed an increased risk for malignant melanoma of the skin amongst persons in the highest socioeconomic group, in agreement with numerous previous studies.[2,9–13] After adjustment for education and income, the pattern of risk remained the same with respect to social class,[14] affiliation to the work market and housing tenure and marital position. In general, survival after melanoma was better for women than men and better for groups of high socioeconomic position, although we saw no dramatic differences in either 1- or 5-year relative survival. Of note is the low relative survival of women in the 'bohemian' social class; however, this was probably influenced by the small numbers in this category. Excess mortality from melanoma was, like survival, associated with low socioeconomic position.

The decreased survival in groups of low socioeconomic position might be due to a number of factors for which we could not control, including less awareness about the disease and less use of primary and preventive care services, resulting in more advanced stage of disease when diagnosed. In this analysis, we could not adjust for stage, anatomical site and whether the melanoma was of the superficial spreading type, all of which could have helped to explain our observations. As suggested earlier,[15] however, the effect of socioeconomic position is probably due to differences in behaviour and in constitutional risk factors in various socioeconomic groups.

The relation between melanoma and socioeconomic position is not simple. It has been hypothesised that the increasing incidence of melanoma in more affluent groups is due to more recreation, especially sun-related activities. In view of the potentially long delay between carcinogenic exposure and melanoma development, it is likely that highly educated, more affluent persons had more extensive sun-related activity in their childhood than groups of lower socioeconomic position. For several decades, the suntan and sun-related activities have been considered to have positive health effects in all socioeconomic strata, and more affluent groups have had more time and money for leisure activities, including exposure to ultraviolet radiation, than poorer groups. Differences in lifestyle and occupation involving

intermittent and intense exposure to the sun in groups of different socioeconomic positions are, however, difficult to assess.

The role of socioeconomic position as a predictor for melanoma might become more diluted, as over the past few decades groups of low socioeconomic position in Denmark have gradually had more leisure time. One might therefore expect to see a growing latent incidence in these groups, and it is surprising that there is still a considerable gap in incidence and survival between socioeconomic groups. Younger generations of high socioeconomic position presumably have greater awareness of the risk factors, resulting in a more precautionary attitude. The question remains whether the expansion of sun-related activities to all social levels can be modified. In Australia, the incidence of melanoma seems to be stabilising, presumably due to preventive campaigns.[12,15]

Strategies to increase public awareness in all social groups are necessary to reduce the rapid increase in incidence in Denmark and the poorer survival of persons of low socioeconomic position.

## Conflict of interest statement

None declared.

## Acknowledgement

REFERENCES

1. Nouri K, editor. *Skin cancer*. New York: McGraw-Hill; 2008.
2. de Vries E, Willem Coebergh J. Cutaneous malignant melanoma in Europe. *Eur J Cancer* 2004;**40**:2355–66.
3. Osterlind A. Malignant melanoma in Denmark. Occurrence and risk factors. *Acta Oncol* 1990;**29**:833–54.
4. Engholm G, Storm H, Ferlay J, et al. *NORDCAN: cancer incidence, mortality and prevalence in the Nordic countries, version 3.1*. Association of Nordic Cancer Registries. Danish Cancer Society; 2008 http://www.ancr.nu.
5. International Agency for Research on Cancer. Solar and ultraviolet radiation, vol. 55. IARC monographs on the evaluation of carcinogenic risks of chemicals to humans. Lyon: International Agency for Research on Cancer; 1992.
6. Østerlind A, Tucker MA, Hou-Jensen K, Stone BJ, Engholm G, Jensen OM. The Danish case–control study of cutaneous malignant melanoma. Importance of host factors. *Int J Cancer* 1988;**42**:200–6.
7. Dalton SO, Steding-Jessen M, Gislum M, et al. Social inequality and incidence of and survival from cancer in a population-based study in Denmark, 1994–2003: Background, aims, material and methods. *Eur J Cancer* 2008;**44**:1938–49.
8. Boyle P, Parkin DM. Statistical methods for registries. In: Jensen OM, Parkin DM, MacLennan R, Muir CS, Skeet RG, editors. *Cancer registration principles and methods. IARC scientific publications no. 95*. Lyon: International Agency for Research on Cancer; 1991. p. 26–158.

9. Aase A, Bentham G. Gender, geography and socio-economic position in the diffusion of malignant melanoma risk. *Soc Sci Med* 1996;**42**:1621–37.

10. Hemminki K, Li X. University and medical education and the risk of cancer in Sweden. *Eur J Cancer Prev* 2004;**13**:199–205.

11. Kirkpatrick CS, Lee JA, White E. Melanoma risk by age and socio-economic status. *Int J Cancer* 1990;**46**:1–4.

12. Pearce J, Barnett R, Kingham S. Slip! Slap! Slop! Cutaneous malignant melanoma incidence and social status in New Zealand 1995–2000. *Health Place* 2006;**12**:239–52.

13. Gallagher RP, Elwood JM, Threlfall WJ, Spinelli JJ, Fincham S, Hill GB. Socioeconomic status, sunlight exposure, and risk of malignant melanoma: the Western Canada melanoma study. *J Natl Cancer Inst* 1987;**79**:647–52.

14. Florida R. *The rise of the creative class*. New York: Basic Books; 2002.

15. Armstrong BK, English DR. Cutaneous malignant melanoma. In: Schottenfeld D, Fraumeni Jr JF, editors. *Cancer epidemiology and prevention*. New York: Oxford University Press; 1996. p. 1282–382.