Socioeconomic status and breast cancer in Denmark

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Accepted 9 July 2002

Background Breast cancer is the most frequent cancer in women and the incidence has increased over time. Our objectives were to study: (1) the socioeconomic differences in breast cancer incidence and mortality in Denmark, (2) how different socioeconomic groups have contributed to the increasing incidence, (3) whether the diverging trend between breast cancer incidence and mortality reflects different socioeconomic distributions of breast cancer cases and breast cancer deaths, and (4) to compare measures of socioeconomic status based on own and spouses’ occupation, respectively. We addressed these questions by studying the socioeconomic distribution of breast cancer incidence and breast cancer mortality in Danish women during the last 25 years.

Methods In all 1 402 225 women in Denmark were individually followed up for death, emigration, and incident breast cancer in 1970–1995. Of the 1 402 225 women included in the study, 730 549 were economically active in 1970, and 480 379 women were both married and economically active. Socioeconomic status was assessed based on the occupation in 1970.

Results For all women classified by their own socioeconomic group, the standardized incidence (SIR) and the standardized mortality ratios (SMR) were highest in academics (SIR = 1.39, SMR = 1.29), and lowest in women in agriculture (SIR = 0.77, SMR = 0.75). For married, economically active women classified by their own socioeconomic group the SIR and SMR were highest in academics (SIR = 1.40, SMR = 1.44) and lowest in women in agriculture (SIR = 0.76, SMR = 0.76). Classified by their husbands’ socioeconomic group, the SIR and SMR were highest in women married to academics (SIR = 1.21, SMR = 1.16) and lowest in women married to men in agriculture (SIR = 0.79, SMR = 0.79). From 1970 to 1995, the risk of developing breast cancer increased by 38% in women aged 50–64. All social groups contributed to this increase, the increase being 45% in unskilled workers, and 26% in academics.

Conclusion During the last quarter of the 20th century academics had the highest risk of breast cancer in Denmark. The size of the social gradient in breast cancer occurrence depended on the measure used. The time trends in social distribution will result in breast cancer becoming more frequent.

Keywords Breast cancer, socioeconomic status, Denmark, cohort study

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Breast cancer is the most frequent cancer in women in the Western world.1 In Denmark, the incidence increased from 43 per 100 000 women in 1945 to 83 per 100 000 women in 19962 (World standard population), whereas the mortality increased only slightly from 23 per 100 000 women in 1945 to 27 per 100 000 women in 1996.3 Similar diverging trends with increases in breast cancer incidence and stable or declining trends in breast cancer mortality are seen in many countries.4–6
With breast cancer now affecting almost one in ten women, it is important to know how this disease burden is shared among women in society. Our objectives were to study: (1) the socioeconomic differences in breast cancer incidence and mortality in Denmark, (2) how different socioeconomic groups have contributed to the increasing incidence, (3) whether the diverging trend between breast cancer incidence and mortality reflects different socioeconomic distributions of breast cancer cases and breast cancer deaths, and (4) to compare measures of socioeconomic status based on own and spouses’ occupation, respectively.

We addressed these questions by studying the socioeconomic distribution of breast cancer incidence and breast cancer mortality in Danish women during the last 25 years.

Material and Methods

We studied the socioeconomic distribution of breast cancer incidence and mortality in Denmark in 1970–1995 among 1 402 225 women aged 20–64 who participated in the census in Denmark on 9 November 1970. The women were individually followed up for death and emigration by linkage of individual census records with the Central Population Register, and for incident breast cancer cases by linkage with the Danish Cancer Register. Causes of death were identified by linkage with the Death Certificate Register. For breast cancer mortality, person-years were accumulated from 9 November 1970 until date of death, emigration, or the end of follow-up on 8 November 1995. For breast cancer incidence, date of breast cancer diagnosis was added as a criterion for censoring. Person-years, incident breast cancer cases, and breast cancer deaths were tabulated by 5-year age groups defined by age at the time of the 1970 census, and by 5-year follow-up periods (Figure 1).

In the 1970 census, each participant was classified by economic status, occupation, and industry at the time of the census. These variables were used as the basis for classification of women into seven broad socioeconomic groups: (1) agriculture, including self-employed and family workers on farms, and unskilled workers in agriculture, (2) urban trade, including self-employed and family workers in shops and smaller companies, (3) academics, including all women with a university education of minimum 5 years, (4) functionaries, including office workers, sales workers, bank clerks, teachers, nurses, etc., (5) skilled workers, including all employees with a education based on an apprenticeship, (6) unskilled workers, including factory workers, cleaning workers, transport workers, etc., excluding unskilled workers in agriculture, and (7) economically inactive, which for women included predominantly housewives.

Three outcome measures were used. First, we analysed all women by their own socioeconomic group. For each socioeconomic group, the observed number of breast cancer cases and breast cancer deaths were compared with the expected number calculated by multiplying the person-years at risk accumulated in each group of women defined by socioeconomic group and 5-year age group at the time of the 1970 census, with the respective rates for all women in the same 5-year age group at the time of the 1970 census. The standardized incidence (SIR) and standardized mortality ratios (SMR) were calculated by dividing the observed number with the expected number. The 95% CI were calculated under the assumption that the observed number of cases followed a Poisson distribution. Second, to measure changes over time cumulative breast cancer incidence rates for women aged 50–64 years were calculated by adding the rates for 5-year age group and multiplying by five (Figure 2). The 95% CI were calculated under the assumption that the observed number of cases followed a Poisson distribution. Third, we calculated SIR and SMR values for married, economically active women by their own and by their husbands’ socioeconomic group using married, economically active women as the reference population (Figure 3).

Results

Of the 1 402 225 women included in the study, 730 549 were economically active in 1970, and 480 379 women were both married and economically active. The analysis of women by their own socioeconomic group thus included 52% of women, while the analysis comparing classifications of women by their own and their husbands’ socioeconomic group included only 34% of women. Of the 671 676 economically inactive women, 559 081 (83%) were housewives. A total of 31 117 071 person-years were accumulated, representing on average 22 years of follow-up.

All women by own socioeconomic group in 1970, reference population all women

The SIR in 1970–1995 was highest in academics (SIR = 1.39; 95% CI: 1.28–1.52), and lowest in women in agriculture (SIR = 0.77; 95% CI: 0.74–0.81) (Table 1). Incidence rates in between were found for functionaries (SIR = 1.16; 95% CI: 1.14–1.18), urban trade (SIR = 1.11; 95% CI: 1.07–1.14), skilled (SIR = 1.04;
95% CI: 0.92–1.18), and unskilled workers (SIR = 0.89; 95% CI: 0.87–0.91). The SIR was close to unity for the large group of economically inactive women (SIR = 0.97; 95% CI: 0.95–0.98).

The SMR in 1970–1995 was highest in academics (SMR = 1.29; 95% CI: 1.12–1.48) and lowest in women in agriculture (SMR = 0.75; 95% CI: 0.69–0.8). In between were skilled workers (SMR = 1.12; 95% CI: 0.91–1.38), functionaries (SMR = 1.09; 95% CI: 1.06–1.12), urban trade (SMR = 1.06; 95% CI: 1.01–1.12), and unskilled workers (SMR = 0.91; 95% CI: 0.88–0.95).

For the large group of economically inactive, the SMR was one (SMR = 1; 95% CI: 0.98–1.02).

There was a wider socioeconomic gradient in breast cancer incidence from 1.39 to 0.77 than in breast cancer mortality from 1.29 to 0.75.

The breast cancer risk increased from 1970–1975 to 1990–1995 in all socioeconomic groups. This is illustrated by the cumulative incidence for the 50–64-year-old women for each of the 5-year periods (skilled workers excluded due to small numbers) (Figure 2). In 1970–1975, the cumulative incidence per 100 person-years was 4.1 (95% CI: 2.8–5.5) in academics, 3.2 (95% CI: 2.9–3.4) in functionaries, 2.9 (95% CI: 2.5–3.3) in urban trade, 2.6 (95% CI: 2.5–2.7) in economically inactive, 2.2 (95% CI: 2.0–2.4) in unskilled workers, and 2.1 (95% CI: 1.7–2.5) in agriculture. In 1990–1995, the cumulative incidence had increased to 5.6 (95% CI: 4.2–7.1), 5.1 (95% CI: 4.9–5.4), 4.5 (95% CI: 4.0–5.0), 3.9 (95% CI: 3.7–4.1), 3.9 (95% CI: 3.7–4.2), and 3.1 (95% CI: 2.7–3.6), respectively. However, while the cumulative incidence had increased by 26% in academics and by 33% in women in agriculture from 1970–1975 to 1990–1995, it had increased by 38% in functionaries, and by 45% in unskilled workers.

Married, economically active women classified according to their own socioeconomic group, reference population married, economically active women

The SIR was highest in academics (SIR = 1.40; 95% CI: 1.25–1.58) and lowest in women in agriculture (SIR = 0.76; 95% CI: 0.72–0.8) (Table 2). Incidence rates in between were found for functionaries (SIR = 1.13; 95% CI: 1.11–1.16), urban trade (SIR = 1.08; 95% CI: 1.05–1.12), skilled (SIR = 0.93; 95% CI: 0.78–1.11), and unskilled workers (SIR = 0.87; 95% CI: 0.85–0.9).

The SMR was highest in academics (SMR = 1.44; 95% CI: 1.20–1.74) and lowest in women in agriculture (SMR = 0.76; 95% CI: 0.70–0.82). Mortality rates in between were found for urban trade (SMR = 1.11; 95% CI: 1.04–1.17), functionaries (SMR = 1.10; 95% CI: 1.06–1.14), skilled (SMR = 0.94; 95% CI: 0.69–1.27), and unskilled workers (SMR = 0.91; 95% CI: 0.87–0.95).
The SIR was highest in women married to academics (SIR = 1.21; 95% CI: 1.14–1.28) and lowest in women married to men working in agriculture (SIR = 0.79; 95% CI: 0.75–0.82) (Table 2). Incidence rates in between were found for functionaries (SIR = 1.12; 95% CI: 1.09–1.15), urban trade (SIR = 1.08; 95% CI: 1.04–1.12), skilled (SIR = 0.99; 95% CI: 0.95–1.03), and unskilled workers (SIR = 0.89; 95% CI: 0.86–0.92). The SIR was close to unity for economically active women married to economically inactive men (SIR = 1.01; 95% CI: 0.94–1.08). In the group of women married to economically inactive men direct age standardization changed the estimate from 1.01 to 0.97, leaving the pattern across groups unchanged.

The SMR was highest in women married to academics (SMR = 1.16; 95% CI: 1.05–1.28) and lowest in women married to men working in agriculture (SMR = 0.79; 95% CI: 0.74–0.81). Mortality rates in between were found for functionaries (SMR = 1.09; 95% CI: 1.04–1.14), men in urban trade (SMR = 1.05; 95% CI: 1.00–1.11), skilled (SMR = 1.01; 95% CI: 0.95–1.08), and unskilled workers (SMR = 0.93; 95% CI: 0.88–0.98). In the group of women married to economically inactive men direct age standardization changed the estimate from 1.04 to 1.08, leaving the pattern across groups unchanged.

## Discussion

During the last quarter of the 20th century, breast cancer incidence and mortality in working women in Denmark was highest in academics and lowest in women working in agriculture. Using all women as the comparison group, academics had almost double the risk of women in agriculture for developing breast cancer. The SIR values were 1.39 and 0.77, respectively. Similar differences were seen among married, economically active women, where the gradient was steeper across the women’s socioeconomic group than across that of their spouses’. In general, having a high breast cancer incidence also meant having a high breast cancer mortality and vice versa. From 1970 to 1995 the risk of developing breast cancer increased in all socioeconomic groups. The increase in incidence was larger among unskilled workers and functionaries than among academics and women working in agriculture, but the rank order between socioeconomic groups remained the same during these 25 years.

Table 2 Number of married, economically active women in Denmark in 1970 aged 20–64 by own and husbands’ socioeconomic group, number of incident breast cancer cases, and breast cancer deaths in this population in the period 1970–1995. Standardized incidence (SIR) and standardized mortality ratios (SMR) for breast cancer. Reference population: married, economically active women

<table>
<thead>
<tr>
<th>Socioeconomic group</th>
<th>Own socioeconomic group</th>
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<tbody>
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<td>Population (1970)</td>
<td>Cases</td>
</tr>
<tr>
<td>Academics</td>
<td>9715</td>
<td>213 919</td>
</tr>
<tr>
<td>Functionaries</td>
<td>360 916</td>
<td>8 272 687</td>
</tr>
<tr>
<td>Urban trade</td>
<td>73 294</td>
<td>1 641 548</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>8821</td>
<td>203 894</td>
</tr>
<tr>
<td>Economically inactive</td>
<td>671 676</td>
<td>14 502 432</td>
</tr>
<tr>
<td>Unskilled workers</td>
<td>226 906</td>
<td>5 107 414</td>
</tr>
<tr>
<td>Agriculture</td>
<td>50 897</td>
<td>1 175 177</td>
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</table>

Total: 1 402 225 | 31 117 071 | 51 721 | 21 576 | 1 | 1 | NR |

a Not relevant.

Table 1 Number of married, economically active women in Denmark in 1970 aged 20–64 by own and husbands’ socioeconomic group, number of incident breast cancer cases, and breast cancer deaths in this population in the period 1970–1995. Standardized incidence (SIR) and standardized mortality ratios (SMR) for breast cancer. Reference population: all women

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Denmark has unique possibilities for studying cancer incidence and cancer mortality by socioeconomic status due to complete population-based health registers and comprehensive use of the personal identification number.7 In the present study, the measure of socioeconomic group was based on occupation recorded at the 1970 census. At the 1970 census, it was compulsory for heads of households to fill out self-administered questionnaires. The questionnaire data were centrally coded in the Danish Statistical Office. No control survey of the 1970-census data was undertaken, but when a sample of the original census questionnaires was retrieved for a nested case-referent study, no coding error of occupation was detected.8

A weakness of the present analysis is that the socioeconomic group was measured only at one point in time. However, although some women will have changed job during the 25-year follow-up period, changes between the major socioeconomic groups used in the present study are unlikely because the jobs in these groups require either educational skills (e.g. for academics, most functionaries, and skilled workers) or property, (e.g. in agriculture) unlikely to be acquired after entry into the labour market. The socioeconomic group is less likely to be stable over time for women economically inactive in 1970. They include a small group of students or unemployed, and a large group of housewives. Many housewives entered the labour market in Denmark during 1970–1995. In 1970, 41% of women aged 20–44 were economically inactive.9 In these same generations aged 40–64 in 1991, only 27% were economically inactive.10

The social gradient in breast cancer incidence and mortality in Denmark is unlikely to be due to social differences in cancer detection. Health care is free of charge, socioeconomic status is not associated with utilization,11,12 and Norredam et al.13 found breast cancer patients from different social groups to have similar distributions of stage of disease at time of diagnosis. Furthermore socioeconomic status was assessed before the cancer diagnosis; i.e. a potential bias caused by a downward drift in the social hierarchy as a result of the disease has been avoided. Part of the increase in breast cancer incidence from 1970 to 1995 could be due to increased diagnostic activity. Mammography screening was, however, only introduced in 1991 in the municipality of Copenhagen, and in 1993 in Funen, covering in total 18% of Danish women aged 50–69.14

In studies of breast cancer incidence, socioeconomic status has been measured by length of education,15–19 area of residence,20–22 occupation and education,23 and occupational groups.24–27 In studies of breast cancer mortality, socioeconomic status has been measured by education,28,29 occupation,30,31 and area of residence.32 Both the highest incidence and the highest mortality have almost uniformly been found in women with a long and higher education, and the Danish data followed this well-known pattern.

The size of the socioeconomic gradient has, however, varied considerably among studies. Our study illustrates that different gradients may derive from use of different methodologies. We analysed both women classified by their own socioeconomic group, and married, economically active women classified by their husbands’ and their own socioeconomic group, and we analysed both breast cancer incidence and breast cancer mortality. We found that the size of the social gradient in breast cancer depended on the measure. The largest gradient was found for breast cancer mortality among married, economically active women classified by their own socioeconomic group, from 1.44 in academics to 0.76 in women working in agriculture. The smallest gradient was found for breast cancer mortality in married, economically active women classified by socioeconomic group of their spouse, from 1.16 in women married to academics to 0.79 in women married to men working in agriculture.

We found similar socioeconomic differences among all women and among married, economically active women. For married, economically active women the gradient was steeper across the women’s own socioeconomic group than across their spouses’. For married, economically active women in Finland breast cancer mortality differentials were wider according to own occupation than according to spouses’ occupation.33 For England and Wales, data were available only for the entire group of married women. The range of breast cancer mortality here was wider according to women’s own socioeconomic class than according to that of her spouse.34 All available data therefore show the widest range of breast cancer mortality when women were classified by their own socioeconomic group.

Our study included 51 721 incident breast cancer cases but only 21 576 breast cancer deaths, reflecting the considerable gap between the risk of contracting the disease and the risk of dying from the disease. The burden of deaths was, however, distributed fairly similarly to the burden of disease. Auvin et al. showed significant differences in breast cancer survival across social classes in Finland 1971–1985.35 The Danish data do not point to a similar pattern. Denmark introduced a nationwide standardization of breast cancer treatment in 1977 including adjuvant chemotherapy. This resulted in equal survival throughout the country for breast cancer patients diagnosed in the period 1978–1987,36 which may suggest that breast cancer patients across socioeconomic groups have benefited equally from the breast cancer treatment in Denmark. Survival data by socioeconomic group are not available for Denmark.

Breast cancer incidence has been on a rapid increase in Finland from 1970 to 1995.23 Trends in socioeconomic differences have been studied with a methodology similar to the one applied in this study. For Finland, a decline in socioeconomic difference has been reported for breast cancer incidence,23 and breast cancer mortality.25 Socioeconomic differences in breast cancer incidence and mortality have also been studied with the same methodology in England and Wales using data from the 1971 Longitudinal Study Cohort.24,30 The trend from 1976 to 1989 showed a fairly unstable pattern across social class, but the results indicated a change from high incidence and mortality in women in non-manual classes to high incidence and mortality in those in manual classes.

In Denmark, the number of newly diagnosed breast cancer cases in women aged 50–64 increased by 42% from 3649 in 1970–1975 to 5196 in 1990–1995. A particularly marked increase of 172% was seen in the number of cases in men. The Danish data followed this well-known pattern.

The size of the socioeconomic gradient has, however, varied considerably among studies. Our study illustrates that different gradients may derive from use of different methodologies. We analysed both women classified by their own socioeconomic group, and married, economically active women classified by their husbands’ and their own socioeconomic group, and we analysed both breast cancer incidence and breast cancer mortality. We found that the size of the social gradient in breast cancer depended on the measure. The largest gradient was found for breast cancer mortality among married, economically active women classified by their own socioeconomic group,
and (2) a spread of the risk pattern of well-educated women to other social groups.

As the well-educated women are presently the group at highest risk of breast cancer this equalization process is then expected to lead to more breast cancer cases.

Conclusion

A considerable socioeconomic difference prevailed in the burden of breast cancer among Danish women in 1970–1995. Academics had the highest risk and women working in agriculture had the lowest risk. The gradient was steeper for married, working women classified by their own socioeconomic group than it was for married, working women classified by their husbands’ socioeconomic group. Our study thus showed that the social gradient in breast cancer risk is dependent on the measure used in the analysis.

The number of newly diagnosed breast cancer cases in women aged 50–64 increased by 42% in Denmark from 1970–1975 to 1990–1995. All social groups contributed to this development, but with an uneven growth rate. Although the rank order between socioeconomic groups remained unchanged during these 25 years, it is expected to diminish with time, and the disease is, as a result of the same process, expected to become more frequent.

Acknowledgement

The Danish Medical Research Council financially supported this study.

### KEY MESSAGES

- During the last quarter of the 20th century academics had the highest risk of breast cancer in Denmark and women working in agriculture had the lowest risk.
- The social gradient in breast cancer occurrence depended on the measure used.
- The time trends in social distribution will result in breast cancer becoming more frequent.

### References


33 Martikainen P. Socioeconomic mortality differentials in men and women according to own and spouse’s characteristics in Finland. Sociology of Health & Illness 1995;17:333–75.

