Yearbook of Population Research in Finland 33(1996), pp. 111–118

Cancer Mortality in Sweden from 1931 to 1992

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Abstract

Trends in age-standardized cancer mortality for Swedish men and women, between 1931 and 1992, were studied using official cause of death statistics. Overall, age-standardized cancer mortality increased by about 16 percent among men and decreased by about six percent among women during the period studied. Among both men and women older than 70 years, age-standardized cancer mortality increased. In all other age groups decreases occurred. During the period studied, a number of changes have occurred that affect cause of death registration, for example, changes in classification routines and improved diagnosis. The exact magnitude of these effects on the observed trends is difficult to estimate, but it seems clear that a bias towards increasing age-standardized cancer mortality has been introduced. Furthermore, this bias may be substantial, thus obscuring the real trends in age-standardized cancer mortality.

Keywords: cancer, mortality, trend, men, women, data quality, Sweden

In Sweden during the 20th century, as in other industrialized countries, cancer has been the second most important cause of death after cardiovascular diseases (Gori and Lynch 1986). In 1931 there were 9,000 deaths in Sweden registered with cancer as the underlying cause of death; in 1992, this figure had increased to 21,000 (SCB 1931a, 1992a). The proportion of all deaths due to cancer has also increased, from about 16 percent in 1931 to about 22 percent in 1992. Parallel to this development a shift in the demographic structure of the Swedish population took place, its numbers increasing some 40 percent and the proportion of the population older than 60 years increasing from about 12 percent in 1931 to about 22 percent in 1992. Cancer is a disease predominant in old age and most of the increase in numbers of deaths caused by cancer can thus be attributed to the change in population structure. Studies of the cancer trend, whether carried out on incidence (the number of newly diagnosed cases of cancer) or mortality (the number of deaths with cancer as underlying cause) therefore need to age-standardize their data in order to make visible changes in cancer mortality or cancer incidence that do not stem from the changes in population structure.

Internationally, incidence data with national coverage over longer periods are generally not available, and the 30–40-year-old Nordic cancer registries stand out as exceptions (Hakulinen et al. 1986). Hence the majority of cancer trend studies have used mortality data (Bailar 1987; Bailar 1990; Bailar and Smith 1986; Bailar and Smith 1987;

Table 1. All cancers combined: direction of changes in age-specific cancer mortality in 16 countries[a].

Age	Men		Women	
	Decrease	Increase	Decrease	Increase
All	2	14	9	7
0–4	15	1	15	1
5–14	16	0	14	2
15–24	16	0	15	1
25–34	15	1	14	2
35–44	13	3	15	1
45–54	9	7	13	3
55–64	6	10	10	6
65–74	6	10	7	9
75–84	0	16	4	12
85–	0	16	1	15

[a] Norway, Greece, Israel, Finland, former Federal Republic of Germany, former German Democratic Republic, New Zealand, United States, Italy, Japan, Hungary, Australia, France, Czechoslovakia, Hong Kong and Singapore.

Source: Bailar 1990, 52–54.

Coggon and Inskip 1994; Davis et al. 1990; Doll 1989; Doll 1990; Hoel et al. 1992; Møller, Mellemgaard and Møller Jensen 1988; Rutqvist, Mattson and Signomklao 1989; Williams and Lloyd 1991). Results from studies in industrialized countries have been similar, showing increases in age-standardized cancer mortality for men, while the picture for women has been less consistent. It is evident from Table 1 that when cancer mortality is broken down in accordance with age and sex, increases are seen mostly among men, and in the oldest age groups, while the younger age groups generally show decreases. International studies have generally concentrated on the last couple of decades, with some exceptions extending back to the 1950s. In Sweden, mortality data with national coverage are available from 1911 onwards, and cancer mortality is fairly comparable over time since 1931. The aim of the present study is to describe the cancer mortality trend in Sweden during the last 60 years. In addition, problems relating to changes in data quality over time, with particular reference to mortality data, and the implications for trend estimation over a long period will be discussed.

Material and methods

In Sweden, the Central Statistical Bureau (SCB) has published causes of death statistics for the whole country since 1911. However, due to changes in classification systems and routines, mortality data concerning cancer are homogeneous only from 1931, when a common Nordic standard for causes of death classification was adopted. In 1951, SCB began to use the WHO manual of the International Statistical Classification of Diseases, Injuries and Causes of Death (ICD) (SCB 1951a). When the ICD code was implemented, a few diagnoses, previously found under other headings in the Nordic classification scheme, were added to the group of cancers. Most notable among these was leukemia. However, it was possible to transfer deaths coded as due to these causes to the cancer group of causes, since they were registered under other headings in the Nordic classification scheme. Hence, comparability was acheived for the period from 1931 to 1992.

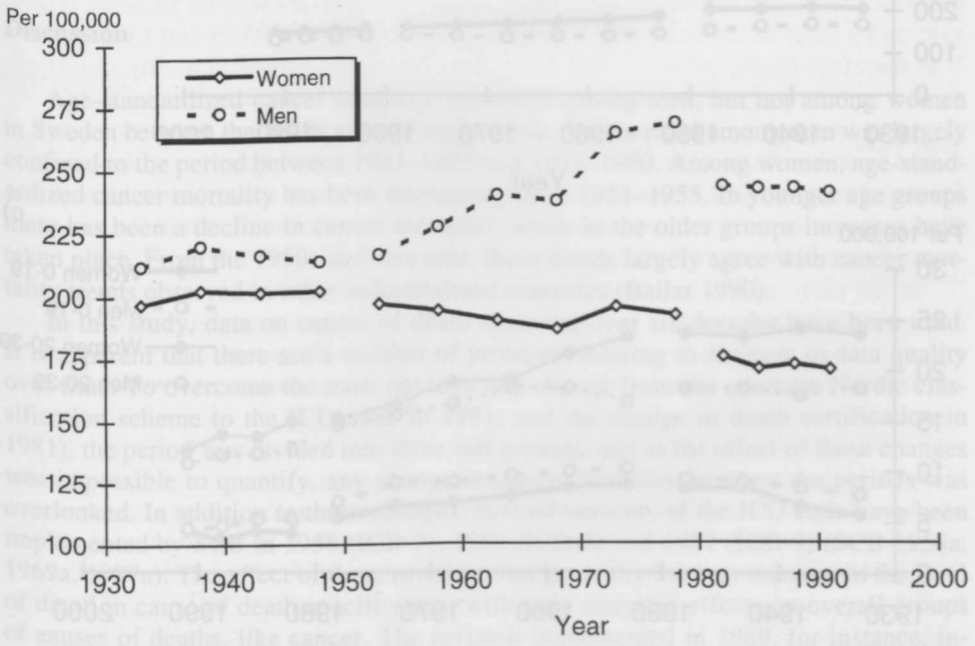
Though the ICD code has been revised a number of times since it was introduced in Sweden in 1951, the impact of these revisions on the group of all cancers has most-

ly been small (SCB 1958a, 1969a, 1987a). An important break in the time series occurred in 1981, when death certificate recording was thoroughly revised, after a report showing substantial inaccuracies (Rutqvist et al. 1989; Westerling 1993). This change in practice led to an artificial decrease in cancer mortality from 1980 to 1981. In order to avoid such undue influence from changes of classification system and death certificate routines, the period under study, 1931 to 1992, has been divided into three sub-periods: The first sub-period covers 1931 to 1950, the second period 1951 to 1980, and the third 1981 to 1992. All data have been age-adjusted, through direct age-adjustment (Breslow and Day, 1987), using the 1970 Swedish census as the standard (SCB 1970b). In order to reduce random variations, age-standardized cancer mortality has been averaged over five-year periods between 1931–1935 and 1976–1980, and three-year periods between 1981–1983 and 1990–1992. When calculating the percentage change in age-standardized cancer mortality over the whole period, changes between the three sub-periods have been set to zero.

Results

Figure 1 shows the total age-standardized cancer mortality between 1931 and 1992 for both men and women. During the first period, 1931 to 1950, there was little change in age-standardized cancer mortality among men and a slight increase among women. Between 1951 and 1980, a large increase was seen for men, while for women age-standardized cancer mortality decreased slightly. During the last period, 1981–1992, age-standardized cancer mortality decreased among both men and women. It is important to note that the downward shift in age-standardized cancer mortality between the second and third period is due to the change in death certification procedures in

Figure 1. Age-standardized cancer mortality per 100,000, men and women, 1931–1992

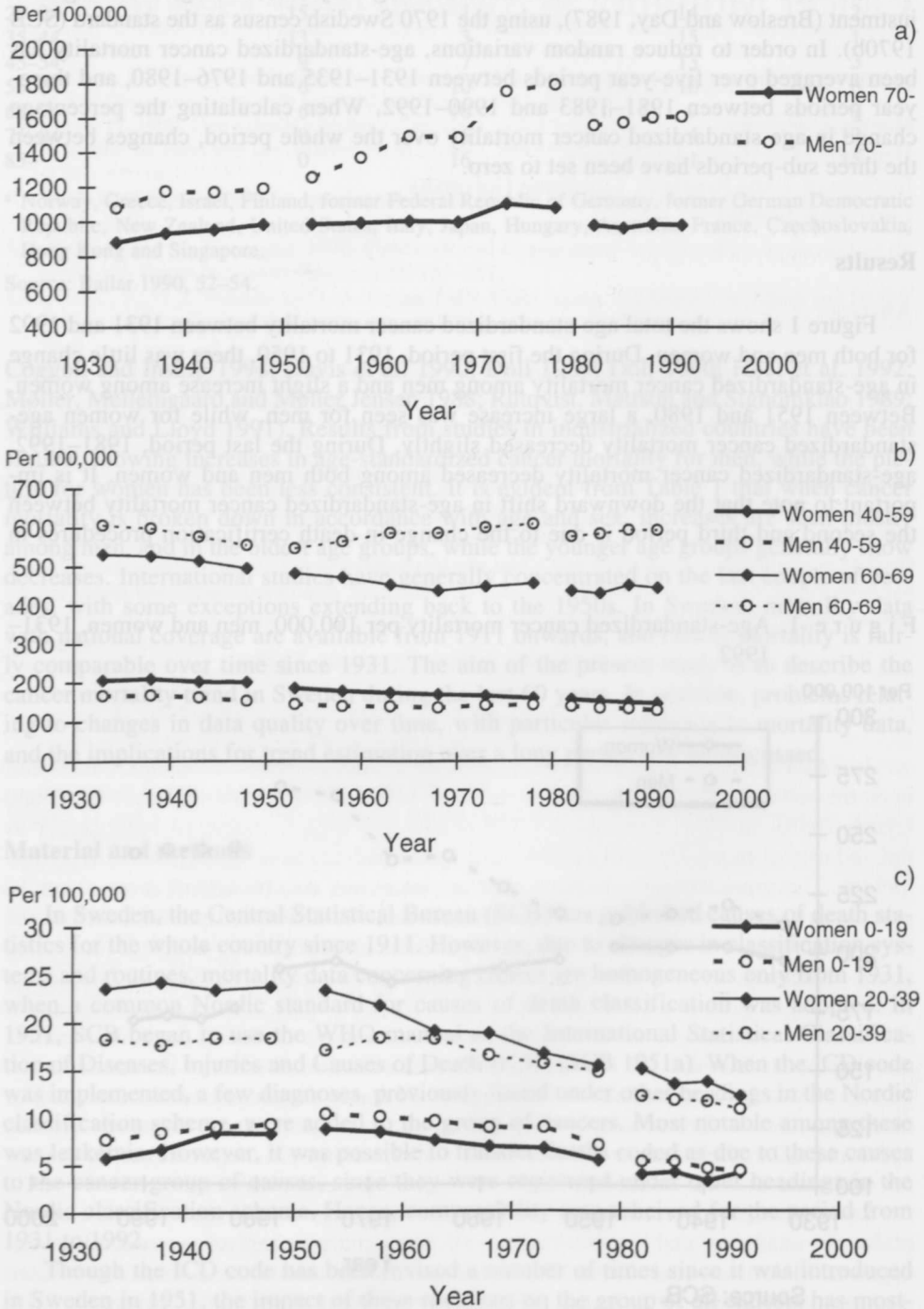


Source: SCB.

1981. The difference in age-standardized cancer mortality between men and women increased from 8 percent in the 1930s and 1940s to about 40 percent in the 1980s.

Figures 2a–c show the development of cancer mortality in different age groups. During the first period, 1931 to 1950, cancer mortality increased or remained constant

Figures 2a–c. Cancer mortality per 100,000 by age and sex, 1931–1992



among both men and women for all age groups except 40–59 years and 60–69 years, where it decreased. In the second period, 1951 to 1980, the largest changes occurred and different age groups displayed different trends. There was also a difference in the trends for men and women in the older age groups. Most striking are the decreases among the younger of both sexes, and the increase among men 70 years and older. During the last period, 1981 to 1992, the decreases in cancer mortality among both men and women aged less than 60 years continued, as did the increases among those 60 years and older. However, decreases tended to be stronger and increases weaker than in the previous period.

Table 2 summarizes the changes over the whole period. Age-standardized cancer mortality increased by about 16 percent among men, and decreased by about six percent among women. For both men and women in the age groups up to 69 years, age-standardized cancer mortality decreased over the period as a whole, while among the older groups increases occurred throughout the period. The strongest decrease for both men and women was found in the age group 20–39 year olds. Among the oldest, 70 years and over, cancer mortality increased by 53 percent among men and 19 percent among women. As a large proportion (almost 50 percent in 1992) of all cancer cases occur in this age group, these increases heavily influence the overall trend.

Table 2. Total percentage change in age-standardized[a] cancer mortality 1931–1992.

	Men	Women
All ages	+16	–6
0–19 years	–48	–10
20–39 years	–41	–49
40–59 years	–24	–27
60–69 years	–6	–14
70 years and older	+53	+19

[a] All figures are adjusted for age and changes in classification systems.

Discussion

Age-standardized cancer mortality increased among men, but not among women in Sweden between the 1930s and the early 1990s. The increase among men was largely confined to the period between 1951–1955 and 1976–1980. Among women, age-standardized cancer mortality has been decreasing since 1951–1955. In younger age groups there has been a decline in cancer mortality, while in the older groups increases have taken place. From the 1950s and onwards, these trends largely agree with cancer mortality trends observed in other industrialized countries (Bailar 1990).

In this study, data on causes of death spanning over six decades have been used. It is apparent that there are a number of problems relating to changes in data quality over time. To overcome the most obvious (the change from the common Nordic classification scheme to the ICD code in 1951, and the change in death certification in 1981), the period was divided into three sub-periods, and as the effect of these changes was impossible to quantify, any change in cancer mortality between the periods was overlooked. In addition to these changes, revised versions of the ICD code have been implemented by SCB in 1958 (ICD-7), 1969 (ICD-8) and 1987 (ICD-9) (SCB 1958a, 1969a, 1987a). The effect of these revisions has generally been an increase in the level of detail in cause of death specification, with only marginal effects on overall groups of causes of deaths, like cancer. The revision implemented in 1969, for instance, included among cancers a number of diagnoses previously found under other headings.

However, this had little impact – an increase of about 100 deaths per year or less than one percent – on the overall number of deaths registered with cancer as underlying cause. An attempt to code a sample of causes of deaths according both to the eighth (implemented in 1969) and to the ninth (1987) revisions, showed that the number of deaths due to cancer increased by only 0.4 percent when causes of death were coded according to the ninth revision as compared to coding according to the eighth (SCB 1990b). Thus the revisions of the ICD code have only had a marginal impact on the total number of deaths coded as due to cancer.

Cause of death registration is based on death certificates. However, at the beginning of the period studied, the first half of the 1930s, no death certificates were issued for about 40 percent of all deaths, most of which occurred in the countryside (SCB 1931a–35a). In these cases, cause of death registration had to be based on other, less reliable information (Inghe 1973). This proportion diminished over time, and since the early 1970s death certificates have been issued for all deaths. Consequently, the quality of cause of death classification has improved. In addition, quality assessments of death certificates (i.e. comparisons of clinically issued certificates with autopsy series) have shown that as many as 30 percent of clinically issued death certificates may be erroneous (Lindahl 1986). A large proportion of these errors remain within the group of cancer, but estimates have shown the total number of deaths coded with cancer as primary cause to be underestimated by up to 20 percent during the 1960s and 1970s (Britton 1974; Hoel et al. 1993). As the autopsy frequency is, and has been, highest among the younger groups, (70 percent among persons 15–44 years old and 60 percent among persons 45–69 years old), this underestimation is most severe in the oldest age groups where the majority of cancers occur (Westerling 1993). Furthermore, diagnostic techniques have improved vastly and knowledge and awareness about cancer has increased during the twentieth century, resulting in declining underreporting of deaths due to cancer (Gori and Lynch 1986). All these changes are likely to have produced spurious increases in cancer mortality over time. An attempt to estimate the impact of such an effect on the US cancer mortality trend suggested that age-standardized cancer mortality in the US actually had decreased continuously for both sexes between the 1930s and the 1970s, while official records showed an increase among men and a slow decrease among women for the same period (Gori and Lynch 1986). It is therefore highly probable that the age-standardized cancer mortality trends observed in this study are, to an unknown extent, biased towards increases by the reduced underreporting of cancer as a cause of death stemming from the eliminations of deaths coded without a death certificate, improvements in diagnosis and increases in autopsy frequency that took place during the period between the 1930s and the 1980s. Hence the observed increase among men is probably overstated, while the observed decrease among women is probably understated.

In the early 1970s, as compared with the late 1960s, a notably large increase in the age-standardized cancer mortality was observed among men (Figure 1). This increase appears to be confined to older men (Figure 2c). There was also an increase in age-standardized cancer mortality among women at the same time, although lesser in magnitude, a break in the otherwise downward trend observed for women between 1951 and 1980. Again the increase appears to be particular to old ages. The reason for this increase is largely unknown but may, to a certain extent, be related to the introduction of a new diagnostic technique, since the effect is seen among both men and women.

In Sweden, incidence data extending back to 1958 exist (Hakulinen et al. 1986). When these data have been used to study the cancer trend in Sweden, steady increases have been the case for both men and women between late the 1950s and late 1980s (Adami et al. 1993; Hakulinen et al. 1986). One of these studies found the increase to be particularly dramatic if successive birth cohorts were studied, with a trebling of

cancer incidence among men and a doubling among women (Adami et al. 1993). A widening gap between cancer incidence and cancer mortality could indicate improvements in treatment, as more get the disease but proportionally fewer die from it. However, while there have been improvements in treatments for certain forms of cancer, for most forms of cancer there is no evidence of increased survival (Stenbeck and Rosén 1995). Reasons for the divergence in trends based on incidence and mortality data are therefore probably found in changing data quality over time, rather than improvements in treatments, since changes in data quality may affect incidence data to a larger extent than mortality data (Boyle 1989).

Diseases grouped under the heading cancer are numerous and quite diverse in nature, and trends for different types of cancer vary widely. The most important variations are the dramatic decline in cancer of the stomach seen among both men and women during the 20th century, and the parallel and equally dramatic increase in cancer of the lung, particularly among men (Coggon and Inskip 1994). While the former trend remains largely unexplained, increases in lung cancer have been attributed to the habit of smoking tobacco that became widespread, particularly among men, during the first half of this century (Doll and Peto 1981).

This study of age-standardized cancer mortality in Sweden shows an overall increase of about 16 percent among men and a slight decrease of about six percent among women between 1931–1935 and 1990–1992. It is also evident that the increase among men took place between 1951–1955 and 1976–1980. However, it has become clear during the discussion that these figures may, for a number of reasons, be highly unreliable. Most notable among these reasons is probably the improvement in diagnosing cancers that has taken place during the latter half of this century. It is therefore likely that increases are overestimated and decreases are underestimated. This implies that any estimate of changes in cancer mortality over long periods, such as those made in this study, will be extremely uncertain. However, since the direction of the errors is known, it is fair to conclude that overall there may have been an increase in age-standardized cancer mortality among Swedish men, and most certainly a decrease among Swedish women, between the 1930s and the early 1990s.

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