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Secular trends in maternal mortality in Sweden from 1750 to 1980

ULF HÖGBERG[1] & STIG WALL[2]

Mortality statistics have been kept continuously in Sweden since 1750 and reveal that the maternal mortality rate declined from 900 to 6 per 100 000 live births over the period 1750 to 1980. Two-thirds of this decrease occurred during the 19th century and the remainder in the 20th century. In the 18th century, 10% of deaths among women aged between 15 and 49 years were due to complications at parturition, but today this accounts for only 0.2% of deaths in women of this age group. Life-table analysis indicates that 1 out of 29 women in Sweden lost her life in parturition during the 18th century, while today only 1 out of 1000 women dies as a result of complications during pregnancy and parturition.

Every year approximately half a million women in the world die today from complications arising during pregnancy and delivery. Maternal mortality is one of the leading causes of death among women of child-bearing age (*1*). Mortality rates associated with pregnancy and parturition are also a sensitive socioeconomic indicator of the health of all women (*2*). From a historical point of view, it has been suggested that maternal mortality is a better gauge than infant mortality of underlying socioeconomic factors that affect health.[a]

The present study describes the results of an analysis of maternal mortality in Sweden over the period 1750–1980. The data should be of wide interest since this period covers Sweden's transition from a poor agricultural country to today's industrialized society.

MATERIALS AND METHODS

Collection of vital statistics and causes of death was initiated in Sweden on a national basis by the *Tabellverket* (Registrar-General) in 1749, earlier than in any other European country, and was taken over by the Central Bureau of Statistics in 1858. Annual aggregated national statistics are therefore available in Sweden from 1749 onwards; their reliability has been discussed elsewhere (*4–6*).[b]

The definition of cause of death has changed over the 230 years that statistics have been kept in Sweden. In 1749 maternal death was taken to be death of a woman from complications arising during pregnancy, labour, or puerperium (*8*, *9*). On this basis only direct, maternal deaths should have been included in the statistics; however, since the clergy were mainly responsible for collecting data in the 18th and early 19th centuries, some deaths resulting indirectly from childbirth, such as pneumonia or heart diseases, were probably also included (*10*). It was not until 1860 that the medical profession became responsible for issuing death certificates in Sweden. The definition of maternal death was revised several times during the 19th century (*11*), and a standardized Scandanavian definition of cause of death was adopted in 1911, to be later modified in 1931 (*12*). Since 1951, the definition of maternal death recommended in the International Classification of Diseases has been used in Sweden (*13*). This includes only direct obstetric deaths and not indirect deaths and is consistent with the definition proposed by the Fédération Internationale de Gynécologie et d'Obstétrique: A maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. This definition is also consistent with the definition of maternal mortality used by WHO (*14*).

Secular analysis of a single cause of death is associated with sources of errors. Deaths from abortions and ectopic pregnancies were probably not included in the statistics of the 18th and 19th centuries; however, they constituted 15% of all maternal deaths in Sweden from 1831 to 1980 (*15*).

[1] Department of Obstetrics and Gynaecology, University Hospital, S-901 85 Umeå, Sweden. Address to which requests for reprints should be sent.

[2] Associate Professor, Department of Social Medicine, University Hospital, Umeå, Sweden.

[a] LITHELL, U. B. *Breastfeeding and reproduction. Studies in marital fertility and infant mortality in 19th century Finland and Sweden*, 1981 (thesis).

[b] PURANEN, B. I. [*Tuberculosis, the occurrence and causes in Sweden, 1750–1980*]. Umeå, Umeå studies in economic history, 1984 (thesis) (in Swedish).

Nevertheless, deaths resulting from abortion are mainly a 20th century phenomenon (*16*). Indirect maternal deaths may have been reported as direct deaths in the 18th and 19th centuries, but this bias also exists in the cause of death statistics for the period 1971–80 (*17*). Of greater importance is whether all direct maternal deaths were reported. In fact, the official statistics may have underestimated the actual maternal mortality by 30% during the 19th century (*18*).

The mortality rates for women of 15–49 years of age were standardized by the direct method, using the age distribution of women in Sweden from 1751 to 1755. The cumulative mortality risk for women was calculated by life-table analysis (*15*). Regression analysis was also used. The number of maternal deaths was converted into a mortality rate expressed either in terms of the number of live births or the number of women of child-bearing age.

The reasons for the reduction in maternal mortality in Sweden have been analysed elsewhere and will not be discussed here (*15*, *20*).[c]

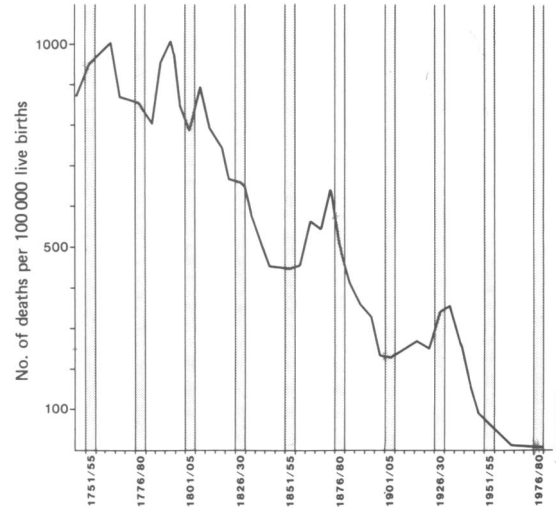

Fig. 1. Maternal mortality rates in Sweden over the period 1751–1980. The plot shows crude death rates per 100 000 live births at 5-yearly intervals.

RESULTS

A total of 103 571 maternal deaths and 23 668 655 live births were registered in Sweden between 1751 and 1980. Over this period a 150-fold reduction in maternal mortality occurred, two-thirds of this being in the 18th and 19th centuries. However, the general decline in maternal mortality was interrupted twice. The first of these occurred during the 1850s and 1860s, when both maternal mortality and total mortality increased. The second retrogression occurred during the 1920s and 1930s, when there was an increase in abortional sepsis because of proliferation of criminal abortions (Fig. 1 and 2).

The greatest decrease in maternal mortality occurred in the 18th and 19th centuries, but the rate of reduction over the last 50 years has been greatest, with a 49-fold reduction compared with a 3-fold reduction during the entire 19th century (Fig. 1).

In contrast, if the maternal mortality rate is expressed as the number of maternal deaths divided by the number of women of child-bearing age, the reduction is even more pronounced. Expressed in this way, the maternal mortality rate decreased 500-fold from 1751 to 1980, and the general female mortality rate over the same period, 9-fold. In 1751, maternal deaths accounted for 10% of the total number of deaths of women aged 15–49 years. This percentage decreased rapidly over the study period and by 1980 was only 0.2%. The factors reducing maternal mortality were therefore remarkably effective—much more so than those controlling general mortality in Sweden (Fig. 2).

Comparison of the percentage reduction in maternal mortality rates among women aged 15–49 years for the periods 1751–1910, 1911–44, and 1945–80 (Table 1) indicates that prevention of maternal mortality was more successful in the first and third of these periods than in the second. Furthermore, comparison of the percentage reduction of

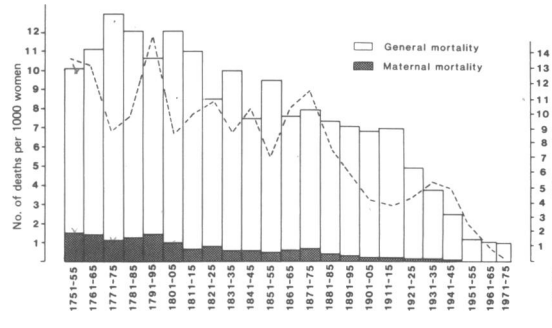

Fig. 2. Maternal mortality rates in Sweden for women aged 15–49 years and the general mortality rate at 5-yearly intervals over the period 1751–1975. The broken curve shows maternal mortality as a percentage of the total number of deaths. Ages were adjusted by the direct method.

[c] HÖGBERG, U. ET AL. *The potential impact of medical technology on maternal mortality in the 19th century* (unpublished).

Table 1. Percentage decline in mortality in various groups and from different causes in Sweden over the periods 1751–1910, 1911–1944, and 1945–1980

Period	Percentage decline in mortality					
	Maternal	Female	Male	Total	Infant	Tuber-culosis
1751–1910	74	41	48	71	60	41
1911–1944	10	46	50	27	30	39
1945–1980	16	13	2	2	10	20

maternal mortality rates with the percentage reduction in the mortality rates from all causes among men and women aged 15–49 years and among infants, and the reduction in the total mortality rate for tuberculosis indicates that maternal mortality was more sensitive than other health indices to preventive measures introduced in the 19th century and to the emergence of modern medicine.

Analysis of life-tables shows that the proportion of a cohort of women aged initially 15 years who survived until they were 50 years of age was 70% for the period 1781–85, 88% for 1931–35, and 96% for 1976–80, i.e., the probability of death in the cohort decreased from 0.30 to 0.04 over the three periods (Fig. 3). From 1781 to 1785 the probability of maternal death was 3.5%, i.e., 1 out of 29 females died from this cause before they reached 50 years of age. This risk had dropped to 1 in 166 by 1931–35 and to 1 in 1000 by 1976–80. The cumulative risk of maternal death therefore decreased approximately 30-fold from 1751 to 1980, compared with a 7-fold

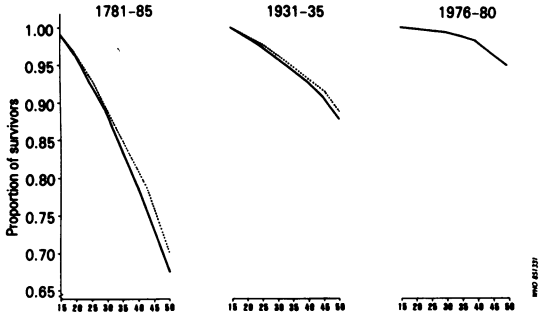

Fig. 3. Secular trends in female survival from 15–49 years in cohorts of women in the periods 1751–85, 1931–35, and 1976–80. The solid curves show the proportion of survivors, whereas the broken curves show the proportion of survivors when maternal deaths are not included.

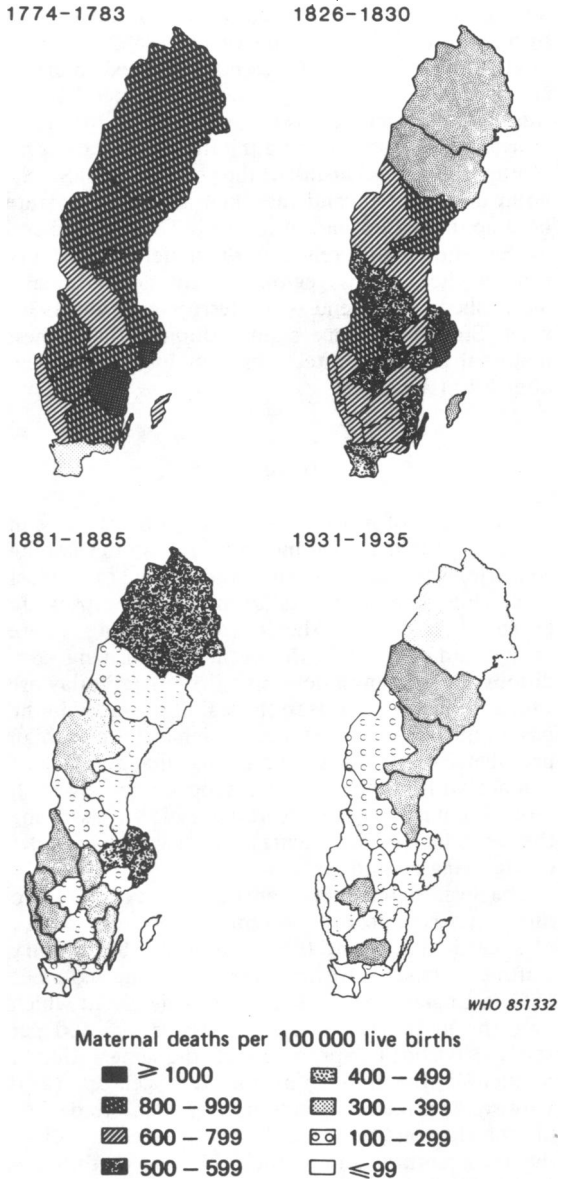

Fig. 4. Regional maternal mortality trends in Sweden per 100 000 live births, by diocese (1774–83) and by county (1826–30, 1884–85, and 1931–35).

decrease in the total mortality of women aged 15–49 years over the same period.

Linear regression analysis of life-table data indicates a positive correlation ($r = +0.83$) between total mortality and maternal mortality in Sweden. The geographical distribution of maternal deaths

during the 18th and 19th centuries in Sweden varies by a factor of 2–7, depending on diocese and county. High maternal mortality was not restricted to urban areas where the mortality rate for puerperal sepsis was high, but occurred also in areas where a high total mortality prevailed. During the first half of the 19th century the general health of the population of Stockholm deteriorated, and the maternal mortality rate became the highest in the country. Towards the end of the century, differences in the maternal mortality rate in the various regions of Sweden gradually diminished. This trend was interrupted in the 1930s when Stockholm once again exhibited the highest maternal mortality rate, caused mainly by criminal abortions (Fig. 4).

DISCUSSION

The results of historical studies can be of value in discussing the maternal mortality rate in developing countries where accurate vital statistics are rare. Most studies of maternal mortality in these countries are based on statistics gathered from hospitals where only a minority of births occur (*22*). Living conditions for women in developing countries today are similar in many respects to those that prevailed in the past in Europe, i.e., existence of high birth rates, high prevalence of malnutrition and anaemia, and lack of contact with competent health personnel. Swedish mortality data may therefore be useful in assessing the reproductive risk facing women who live under trying living conditions.

The Swedish mortality statistics refer exclusively to direct maternal deaths and represent the only source of such data covering the situation in 18th-century Europe. Similar statistics have been collected since 1857 in England by the Registrar-General, at which time the maternal mortality rate was 400–500 per 100 000 live births, approximately the same as that in Sweden in the middle of the 19th century (*23*). However, unlike the situation in Sweden, no decline in mortality rate occurred during the second half of the 19th century, and at the beginning of the 20th century the maternal mortality rate in England was twice that of Sweden, which, together with the Netherlands, had the lowest rate in Europe (*24, 25*). National maternal mortality rates from the USA appeared for the first time in 1918 and were three times as high as the corresponding rates in Sweden (*26*).

It has been claimed that the decline in maternal mortality is a 20th century phenomenon (*27*). This certainly seems to have been the case in England, but not in Sweden, where the greatest reduction in maternal mortality occurred during the 19th century. If, as has been suggested, Swedish statistics underestimated the true maternal mortality during the 19th century by 30% (*18*), the decline observed at the end of this century, when the quality of cause of death statistics improved, is all the more remarkable. The precipitous drop in maternal mortality rates over the last 50 years is a phenomenon of all developed countries (*27–33*). Developed countries attained maternal mortality rates of below 50 per 100 000 live births during the 1970s, the lowest figures being in Scandinavia, where the rates are normally below 10 per 100 000 live births (*34*).

Only a few countries report annual maternal mortality rates. In general, African and Asian countries publish statistics about the age, sex, and cause of death for only 10% of their populations. Half of the Latin American countries have reliable statistics. The maternal mortality rates reported from developing countries range from 60 to 456 per 100 000 live births (*14*); however, a few of the least developed countries report maternal mortality rates of greater than 500 per 100 000 live births (*35*). Data from maternity hospitals in Africa indicate maternal mortality rates of 200–500 per 100 000 live births (*36–39*). Maternal mortality rates from developing countries are, however, probably higher than official statistics suggest; for example, in Bangladesh, one study has indicated a maternal mortality rate of 800 deaths per 100 000 live births (*40*), a value equivalent to the rate that prevailed in 18th century Sweden.

Several historical studies have discussed the distribution of maternal mortality in Europe. Such studies have used mortality rates comprising not only direct obstetric deaths but also indirect deaths associated with pregnancy. The earliest maternal mortality records were kept in a late 16th century English parish, where a maternal mortality rate of 2350 per 100 000 births prevailed (*41*). By means of the family reconstitution technique, the maternal mortality rate in England during the 17th and 18th century has been estimated to have been 1000–1500 per 100 000 births, which is less than the rate of 1400–5900 for 17th century England as published in the Bills on Mortality (*23*).

In France, two historical studies have been made of maternal mortality rates. Among 877 families in a French village a maternal mortality rate of 2360 per 100 000 births was calculated for the period 1666–1814 (*42*). In the second study, a regional variation of 1000–2800 was observed in a study of 39 French villages over the period 1700–1829 (*43*). Very high maternal mortality rates, 1470–1920 per 100 000 births, have also been noted among the ruling families of early modern Europe (*44*). It has been suggested that the latter rates, along with those on infant mortality, are probably lower than those of the general population over the same period (*44*). However, the mortality rates estimated for the

general population, using the family reconstitution technique, are approximately the same as those of the ruling families. If these rates are correct, they are therefore inconsistent with the proposed use of maternal mortality rate as a socioeconomic, dependant variable. It should be noted that some risk factors, such as teenage pregnancies, multiparity, wearing of costumes that had an adverse effect on women's health, and poor birth attendance practices, may have been more prevalent in the ruling families than in the general population.

Furthermore, a high maternal mortality rate of 1780 per 100 000 was prevalent in the 17th to 19th centuries in rural Germany (*45*). The catastrophic effects of this extremely high maternal mortality rate have been studied in four German parishes where 1 in 20 women died from the consequences of childbirth. This study revealed an excessive mortality among married females of child-bearing age in comparison with males, even if maternal deaths were excluded (*27*). In addition a study of female mortality in England in the 16th and 17th centuries indicated excessive female mortality caused by maternal deaths (*46*). The same trend can be found in France during the 19th century, but not in Sweden (*3*, *7*). This may indicate that Swedish peasant women enjoyed a better status than in other European countries, and it further strengthens the hypothesis that Sweden had a lower proportion of maternal deaths in the 19th century than the rest of Europe.

The high maternal mortality rates in Europe indicated by historical studies have their counterpart today. For example, in Bangladesh a higher age-specific mortality rate has been reported for females of 10–49 years of age than for males, which was largely caused by maternal deaths (*40*). Also, in India, Pakistan, and Sri Lanka during the 1950s and 1960s the female mortality rate was higher than that of males, partly because of a high maternal mortality rate but also because of the harsher living conditions of women in these countries (*21*).

In conclusion, it can be stated that in societies with a high overall mortality rate fatal complications during childbirth present a threat to women of child-bearing age. Nevertheless, it can be successfully reduced by preventive measures and medical care.

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RÉSUMÉ

TENDANCES SÉCULAIRES DE LA MORTALITÉ MATERNELLE EN SUÈDE DE 1750 À 1980

Chaque année, un demi-million de femmes environ meurent dans le monde de complications de la grossesse ou de l'accouchement. La mortalité maternelle est l'une des principales causes de décès chez les femmes en âge de procréer. Des études historiques sur les taux de mortalité maternelle enregistrés autrefois en Europe pourraient aider à évaluer la situation actuelle dans les pays en développement où de bonnes statistiques d'état-civil font souvent défaut.

La Suède a procédé en 1749, bien avant les autres pays d'Europe, à un recensement national et à l'enregistrement des causes de décès. Ces données couvrent la période pendant laquelle la Suède est passée du stade de nation agricole pauvre à celui de nation industrielle. La présente étude analyse les taux de mortalité maternelle en Suède de 1750 à 1980, indiquant les tendances de leur déclin et le risque cumulatif de décès associé à la reproduction. Les taux de mortalité ont été normalisés selon la méthode directe et le risque cumulatif de mortalité chez les femmes a été calculé au moyen de l'analyse des tables de mortalité. L'article étudie les sources possibles de biais dans l'analyse séculaire.

Le taux de la mortalité maternelle en Suède est passé de 900 à 6 pour 100 000 naissances vivantes entre 1751 et 1980, les deux tiers de cette régression se situant au 19^{e} siècle et le reste au 20^{e} siècle. Au 19^{e} siècle, 10% environ des décès de femmes entre 15 et 49 ans étaient dus à des complications de la grossesse ou de l'accouchement; ajourd'hui, ce taux n'est plus que de 0,2%. L'analyse des tables de mortalité montre qu'au 18^{e} siècle, une femme sur 29 mourait en couches. Aujourd'hui, on enregistre un décès pour 1000 accouchements. Durant la période à l'étude, la réduction des décès maternels en Suède a été supérieure à celle des décès par autres causes. Les taux élevés de mortalité maternelle qui prévalaient en Suède au 18^{e} siècle correspondent aux taux actuels des pays en développement et les résultats de cette étude pourraient aider à agir aujourd'hui dans ces pays.

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