MATERNAL MORTALITY IN SWEDEN

by

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Umeå 1985

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"Do not go gentle into that dark night,
Rage, rage, rage, against the dying of the light".
Dylan Thomas

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ABSTRACT

Every year about half a million women die from complications of pregnancy, parturition and puerperium, most of which are preventable. The purpose of this thesis was to chart the distribution and decline in maternal mortality in Sweden between 1751 and 1980, and furthermore to characterize positive (predisposing) factors and negative (protective) factors of maternal mortality.

Maternal mortality declined from 900 to 6.6 per 100,000 live births in these 230 years. Maternal deaths accounted for 10% of all female deaths in the reproductive ages between 1781 and 1785, but only 0.2% between 1976 and 1980. However, in the 19th century 40-45% of the female deaths in the most active childbearing ages were maternal deaths. The children left motherless had an extremely high mortality. Indirect maternal deaths and puerperal sepsis accounted for the bulk of maternal deaths in the rural areas. Only a minority of maternal deaths occurred in lying-in hospitals. Midwifery services in rural areas and antiseptic techniques were most effective in preventing maternal deaths during the late 19th century. The changing distribution of age and parity amongst the parturients had a definite impact on the mortality decline, enhanced by time, contributing to 50% of the mortality decline over the last 15 years. The expontential decline of cause-specific mortality and case fatality rates during the last 40 years is furthermore explained by the emergence of modern medicine - antibiotics, antenatal and obstetric care. The earlier serious problem of illegal abortions was eradicated by legislation and changes in hospital practice. The maternal mortality decline has levelled out during the 1970s, the relative importance of embolism as a cause of death is increasing. Advanced age and intercurrent disease are the most difficult risk factors to overcome.

To conclude, this study indicates that the reason why maternal mortality has declined faster than other health indices is that the major part of the maternal deaths can be prevented by medical technology, including family planning, antenatal and obstetric care.

This experience should be of interest to developing countries where high rates of maternal mortality prevails.

Key words: history of medicine, maternal health services, family planning, pregnancy complications, legal and illegal abortions, puerperal infections, embolism, cesarean section, maternal mortality, pregnancy care.

This thesis is based upon the following papers, referred to in the text by Roman numerals:

I.   Högberg, U., Wall, S: Secular trends of maternal mortality in Sweden for the years 1750-1980. Bulletin of the World Health Organization. In press.

II.   Högberg, U., Broström, G: The demography of maternal mortality - seven Swedish parishes in the 19th century. International Journal of Obstetrics and Gynecology. In press.

III. Högberg, U., Wall, S., Broström, G: The potential impact of medical technology on maternal mortality in the 19th century. Submitted for publication.

IV.   Högberg, U., Wall, S: Age and parity as determinants of maternal mortality - impact of their shifting distribution amongst parturients in Sweden 1780-1980. Bulletin of the World Health Organization. In press.

V.   Högberg, U., Joelsson, I: The decline in maternal mortality in Sweden, 1931-1980. Acta Obstetricia et Gynecologica Scandinavica. In press.

VI.   Högberg, U., Joelsson, I: Maternal deaths related to abortions in Sweden, 1931-1980. Gynecologic and Obstetric Investigation 1985;20.

VII. Högberg, U., Joelsson, I: Amniotic fluid embolism in Sweden, 1951-1980. Gynecologic and Obstetric Investigation 1985;20

VIII. Högberg, U: Maternal deaths related to cesarean section in Sweden 1951-1980. Obstetrics and Gynecology. Accepted for publication.

IX.   Högberg, U: Maternal deaths in Sweden 1971-1980. Acta Obstetricia of Gynecologica Scandinavica, Accepted for publication.

INTRODUCTION

"No death in childhood or old age can approach in poignancy the death of a young woman in childbirth. I well remember the first maternal death I witnessed very early in my consultant practice. I had been called in to assist a doctor who was in difficulties with a twin delivery in a toxemic woman who had had a gross hemorrhage. She died before blood was available, and the subsequent interview with the patient's bereaved husband and mother is indelibly inscribed on my mind." Francis J. Hayden (1).

Reproduction of mankind has specific characteristics different it from other mammals. Toxemia, placenta praevia and abruptio placentae are all life threatening complications of pregnancy and delivery, unknown among other mammals (2,3). The narrow limits of the newborn brain and the mother's pelvis with possible obstructed labor is another constraint on smooth human parturition (4,5). The other main causes of maternal death are abortion, ectopic gestation, thromboembolism, infection, and postpartum hemorrhage (6). A higher susceptibility to infectious diseases during pregnancy also exposes women to an increased death risk (7-9).

Maternal mortality is one of the major death causes among women in their reproductive years (10). It is estimated that every year half a million in the world die from complications of pregnancy, parturition and puerperium. This number is unreliable because census and cause of death registration cover only a part of the world population (10,11). Mortality rates of 100-3,500 deaths per 100,000 live births are reported from the developing countries (10-18). In the developed countries, maternal mortality rates of 6-150 per 100,000 live births are reported (12,19-25). What predisposing factors create the epidemiological feature of maternal mortality?

Age and parity are biological determinants affecting the rates of maternal mortality. An increased risk is described out of the optimal age interval of reproduction (10,26,27). Multiparity is associated with an increased risk of unfavorable outcome (27-30). The decline in maternal mortality in the developed countries had been associated with the last stage of the demographic transition (6), but earlier studies were inconclusive regarding the effect of changing age and parity on the decline in maternal mortality (30-34).

Socio-economic deprivation is described as the major factor underlying high maternal mortality (35-38). Maternal mortality rates are also proposed as a sensitive indicator of the health of women out of reproductive age (39). In historical studies too, maternal mortality has been suggested as being a better approximation than infant mortality for describing implicit socio-economic factors (40). General improvements in public health have been proposed as underlying the decline in maternal mortality in developed countries (41-44).

Antenatal care was developed in the early 20th century in order to combat maternal mortality (45-47). The discovery of antibiotics, followed by other technical advances of modern medicine, are associated with the decline in maternal mortality. The rate of maternal mortality has been claimed to be an indicator of the standard of antenatal and obstetrical care (48-50). Medical technology could be of greater importance than underlying socio-economic factors in reducing maternal mortality. Women from a religious group in the U.S.A., who avoided the modern antenatal and obstetric care, had a maternal mortality of 872 per 100,000 live births during the years 1975-1982 (51), while the ruling families of the Ancien Regime in Europe had mortality rates of 1,470-1,920 (52).

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AIMS

Historical studies in developed countries are considered to be of great value in the understanding and prevention of maternal deaths in developing countries of today. This thesis, based upon Swedish census and death cause registration, deals with maternal mortality in Sweden spanning a period of 230 years (1751-1980). The aims of the study were:

- To describe decline in maternal mortality and its demographic impact
- To explore predisposing, positive, risk factors of maternal mortality
- To characterize and estimate the potential impact of protective, negative, risk factors of maternal mortality.

MATERIALS AND METHODS

In the 17th century the Swedish clergy created an information system covering all individuals in their parishes above the age of 6-7. This registration reached a high standard in the middle of the 18th century, when it included the whole population. The information system was based upon the Catechetical Examination Registers, and was revised annually. To this "church book" other types of records were also linked; records of in- and out-migrations, of births and baptisms, of banns and marriages and of deaths and burials.

Tabellverket (The Office of the Registrar General), founded in 1749, compiled national statistics as a census and cause of death registration. National vital statistics were therefore available in Sweden earlier than in any other European country. In 1858 Tabellverket became the Central Bureau of Statistics. The reliability of these statistics has been discussed by others (53-56).

Among the causes of death, only maternal deaths have been has been reported uninterruptedly throughout the study period (57-60). The concept of causes of death has changed during the 230 years of statistics in Sweden. A maternal death used to be defined as death of a woman caused by complications of pregnancy, labor, or puerperium (61,62). By this definition only direct obstetric deaths were recorded, but the fact that the clergy were mainly responsible for the reports may have resulted in some indirect obstetric deaths like pneumonia and heart diseases being included in the reports (63). The death cause list was revised several times during the 19th century (64). A standardized Scandinavian death cause list was adopted in 1911, and then modified in 1931 (65). The doctors were made responsible for death certification in urban areas by 1860, and in the rural areas by 1911.

Since 1951 maternal deaths in Sweden have been defined according to the International Classification of Diseases (6-8th editions) adopted by the World Health Organization (66). This is only synonymous with direct obstetric death as defined by the Committee on Maternal Mortality of the International Federation of Gynecologist and Obstetrician: "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...Direct obstetric deaths: those resulting from obstetric complications of the pregnant state...Indirect obstetric deaths: those resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiologic effects of pregnancy." (67). The time interval, 42 days, of the puerperal deaths could be verified only for the years 1951-80.

The numbers of maternal deaths, distributed by county, are available for the whole period (57-59). The numbers of maternal deaths, distributed by age, are available on a more limited scale: for 1774-1791 by 5-year age intervals (57), for 1911-1920 by 10-year age intervals, and for 1922-1980 by 5-year intervals (59). The distribution of births, live as well as stillbirths, are reported annually by county and by age (57,58,68,69). No national data about deaths distributed by parity are obtainable before the year 1951.

The 19th century "church books" from seven Swedish parishes (Fig 1), covering 0.27% of all births in Sweden, have been used as a subsample. These parishes have not been included in the study as representative samples, but constitute the only information so far obtainable from this period. However, all the parishes are scattered throughout Sweden and were located in rural areas where 90% of the population lived at that time. Data on the individuals, time of birth and death by month and year, residence, occupation, marriage, children and reports on catechetical examination, were entered into a computer and are available for research at the Demographic Data Base, Umeå University (70).
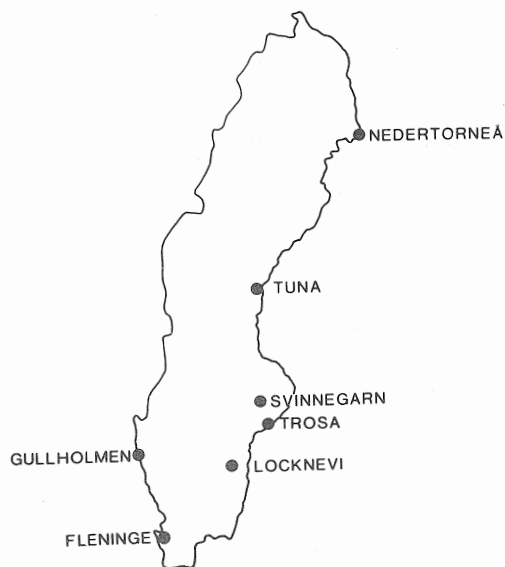
Fig. 1. Geographical distribution of the seven Swedish parishes included in the sample from the Demographic Database at Umeå University.

A precondition for the identification of a maternal death is that the woman had given birth to an infant live or stillborn, within 42 days before her death, as the data files are based upon the birth records and not death cause registration. As the distribution of births by age in the seven parishes does not differ from the national data, it is assumed that the distribution of birth by parity also follows the same pattern.

From 1951 onward, maternal deaths can be identified individually, as since then all death certificates have been centrally filed at the Central Bureau of Statistics. These death certificates have been requisitioned, together with hospital records and autopsy reports from obstetrical departments. Information on the number of births at each obstetrical unit, and figures regarding attendance at antenatal clinics are obtained from official statistics at the National Board of Health and Welfare (71). Three sources are used for the calculation of incidence and fatality of certain pregnancy and delivery complications and interventions:

1. annual reports from obstetrical departments, containing information on the number of deaths from eclampsia (72);
2. records from the obstetrical departments of the county of Västerbotten for 1955-1972 (73);

3. the Swedish Medical Birth Registry containing records of pregnancy and delivery complications from the years 1973-1980 (69).

The rate of maternal deaths is expressed as the number of deaths per 100,000 population at risk, ie live births. The number of confinements (maternities) is also employed as denominator if appropriate or if no other information is available. This discrepancy is, however, of minor consequence for the analysis. Age-adjusted mortality rates are applied to describe time trends. Adjusted rates are calculated by applying the observed age-specific death rates of a given calendar period to the age structure of the common standard population: in this way the age structure remains unchanged throughout the whole period and the comparisons over time avoid confounding from age.

Measures of potential impact refer to the effect of a change in certain risk factor distributions. Impacts could be "etiologic" or "preventive", depending on whether changes are predisposing (positive) or protective (negative) regarding the death risk. To estimate the potential impact, both the relative risk that can be ascribed a certain etiologic or protective factor, and the prevalence of the same factor in the population are required. By establishing a factor as a determinant of the mortality rate, the proportion of deaths caused by the exposure of the risk factor can be estimated. Risk ratio is defined as the risk relative to a certain reference category. Etiologic fraction is concerned with positive, predisposing or contributive risk factors and is expressed as the quotient between the number of new cases attributable to the risk factor and the cases observed. The prevented fraction deals with negative, protective risk factors. The prevented fraction is defined as the quotient between the cases that would have occurred in the absence of the exposure minus the cases that did occur (prevented cases) / and the cases that did occur (74-76).

The cumulative mortality risk is calculated by life table analysis (77). Simple regression analysis has also been employed.

Data extracted have been computerized by the Medical Information Handling Unit, MEDIFO, at Umeå University (73). The descriptive statistics are based on a computer "package" (78). Logistic multiple regression techniques were used in analyses of possible association between maternal mortality and age, parity, profession and marital status in the seven parishes (79).

Parity is defined as the numbers of previous pregnancies ending in registrable births or stillbirths, plus

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fatal pregnancies irrespective of duration. Fatality rate is defined as the number of deaths per certain number of diseased or procedures. Cause-specific mortality is defined as the number of deaths per 100,000 population at risk. Incidence rate refers to the number of cases per 1,000 population at risk.

Each individual case of maternal death during the years 1951-1980 is analysed as regards obstetric history and pregnancy outcome. The death cause and associated features are, if necessary, revised according to section XI (630-678) of ICD 8th Edition. When there is more than one possible cause of death, priority is given to the obstetric procedure one judged most likely to have been causative. Amniotic fluid embolism is diagnosed with the clinical chararecteristics, and when the diagnosis is confirmed by histological examination, or when the pathological examination can exclude other causes of death. Each death case is classified as a high or low risk case before gestation and also during pregnancy and delivery (37,81). After assessment of the circumstances of each case, the "possible preventability" of the particular factors resulting in the fatal outcome are considered. The factors are classified as "avoidable" if an alternative choice of action could have prevented or reduced the likelihood of death. As classified according to preventable factors, responsibility is categorized as follows:

1. obstetrician/midwife,
2. parturient,
3. other (health care distribution, legislation, laboratory facilities) (82,83).

RESULTS AND COMMENTS

A total of 76,776 maternal deaths were registerered in the Swedish national statistics between 1751 and 1900 (IV). Of 170 maternal deaths on record in the seven parishes, only 70% were identified in the aggregated statistics (II). However, both the subsample and the national statistics also included some indirect maternal deaths (I,II). 26,047 maternal deaths were recorded in the official statistics between 1901 and 1950. No other source for cross-checking was available for the period.

Between 1951 and 1980, 738 maternal deaths were reported in the official statistics. 732 of them could be identified by death certificates, and furthermore 6 deaths which had not been reported in the official statistics. An additional 3 cases were obtained from the obstetrical departments between 1971 and 1980. Altogether 747 maternal deaths were thus registered between 1951 and 1980. Records and autopsy reports were available for 629 and 582 respectively of the fatalities (V). The Swedish Medical Birth Registry had recorded 26 of the 35 deaths related to parturition and puerperium between 1973 and 1980 (VIII).

The main cause of death was amended in 65 (9%) of the cases between 1951 and 1980 (V). 6 maternal deaths (9%) which had been classified as direct deaths were re-classified as indirect for the years 1971-80 (VIII).

Mortality decline and demographic impact

At the beginning of the period, maternal deaths accounted for 10% of all female deaths between the ages of 15 and 49 years, as against only 0.2% by the end of the period. The life table analysis shows that for the years 1781-85 one out of 29 females died in childbirth before the age of 50. This risk dropped to 1 in 166 for the years 1931-35, and one in 1,000 for 1976-80. Thus, the cumulative risk of maternal death decreased 30-fold, compared with a 7-fold decrease in the total mortality of females in their reproductive years.

The real extent of maternal mortality and its consequences in the 19th century were illustrated by the study of the seven parishes. In the most active range of reproduction, 20-34 years of age, 40-45% of deaths among married females were caused by complications of pregnancy or delivery. One out of 14 married women died in childbirth, while only one of 142 unmarried women died in childbirth. Of those children who lost their mother at birth, and their siblings under the age of one year, only 1.6% and 3% respectively survived their first five years. Of those children aged 1-5 when their mother died, only 13% survived for five years. Only children over the age of 5 when losing their mother were out of risk (II).
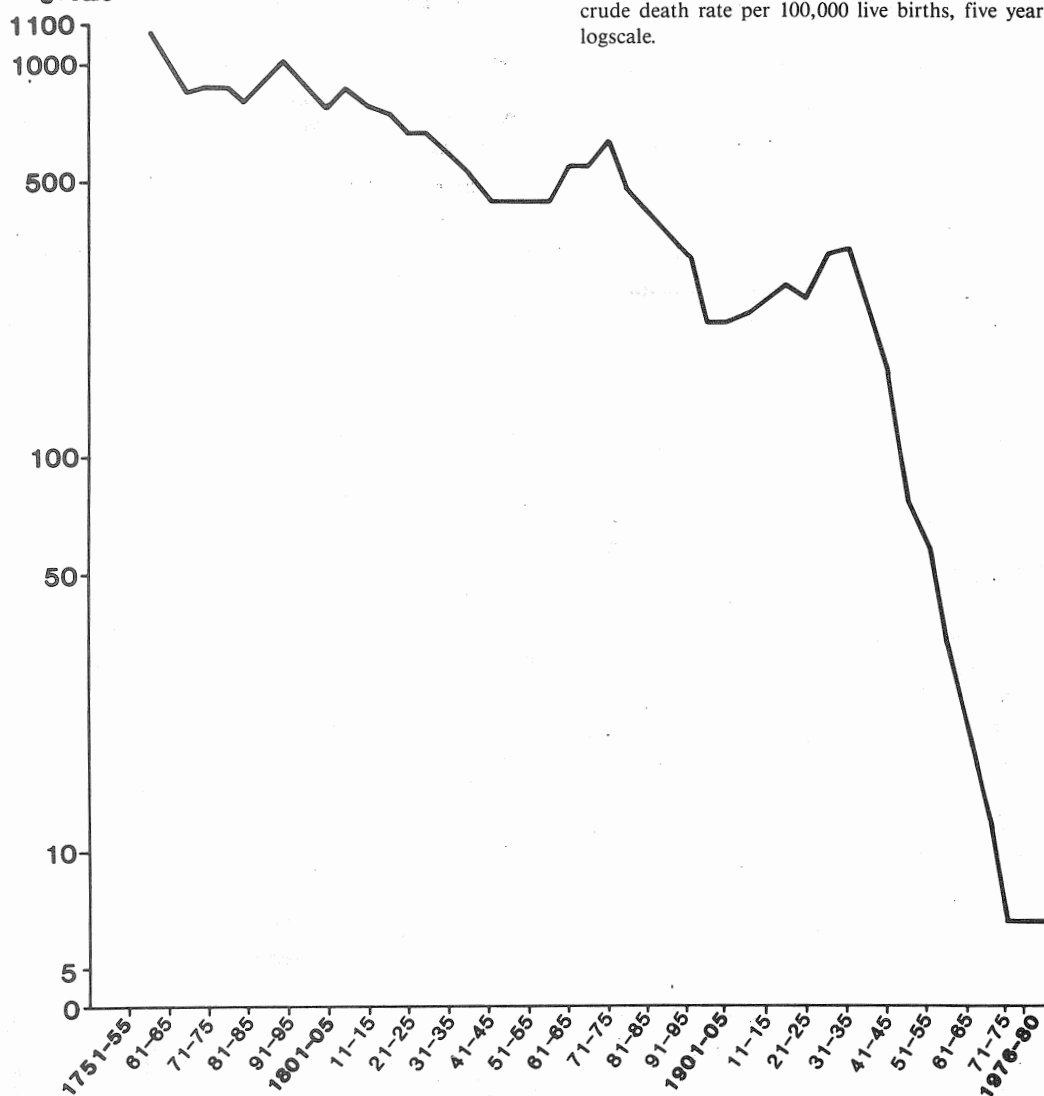
Fig. 2. Maternal mortality in Sweden between 1751 and 1980, crude death rate per 100,000 live births, five year mean, logscale.

Maternal mortality has declined from 900 to 6.6 per 100,000 live births during the 230 years studied - a 150-fold reduction (Fig 2). The major decrease in mortality occurred before the 20th century, but the most steepest decline has taken place during the last 50 years with a 49-fold reduction (Fig 2, Table I). The general trend towards a decline has been interrupted twice. The first interruption occurred between 1850 and 1880, when the recorded septic maternal mortality coincided with an increase in total mortality (I,IV). The second retrogression can be observed during the 1920s and 1930s, when there was an increase in abortional sepsis due to criminal abortions (VI).

During the 19th century, areas of high maternal mortality were not restricted to the urban environments with known high death rate of puerperal sepsis, but rather to areas with a known high total mortality (I). During the 20th century there is a levelling out of the differences in mortality between the counties, broken only during the 1930s with the urban areas exhibiting the highest death rates, due mainly to criminal abortions (I,VI).

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Cause-specific mortality

In the national statistics, little is known about the distribution of cause-specific mortality before the 20th century. However, some information is available from the seven parishes. 133 out of 170 recorded deaths had a specified death cause. Two-thirds of the maternal deaths were directly obstetrical - difficult labor, eclampsia, hemorrhage and sepsis, whereas one-third were indirect obstetric deaths such as pneumonia, tuberculosis and dysentery (II). In the lying-in hospitals, most maternal deaths were caused by puerperal sepsis before the antiseptic techniques became known (III).

However, the epidemics of puerperal sepsis in the lying-in hospitals did not dramatically alter the national mortality rates. For the period 1775-1900, 1,720 parturients were recorded as having died from puerperal sepsis in the lying-in hospitals. This is only 2.2% of all maternal deaths during the period. When the national statistics recorded puerperal sepsis separately, during the second half of the 19th century, the nationwide problem became obvious. 54% of deaths between 1861 and 1900 were caused by puerperal sepsis (IV).

After the introduction of antiseptic techniques, no further decline in puerperal sepsis mortality occurred until the 1930s. The major mortality reduction was observed during the subsequent decades (Table I). Six women died of puerperal sepsis during the 1970s, 4 following cesarean section and the other 2 in connection with premature rupture of the membranes and fetal death (VIII).

The diagnosis puerperal sepsis was probably not confounded by septic abortions during the 19th century (VI). However, during the 1920s the puerperal sepsis mortality increased, reaching a peak during the early 1930s (VI). This increase was due to abortional sepsis, synonymous with illegal abortion deaths. Abortional sepsis mortality was sharply reduced during the 1940s (Table I). Until the elimination of illegal abortions during the 1960s, most abortional deaths were attributable to illegal abortions with air embolism and sepsis as specific death causes (VI).

The risk of dying from an abortion procedure was one-fourth of that involved in giving birth at term during the years 1931-35, while declining to one-tenth during the years 1971-80. This has been achieved by the introduction of legal abortions (VI). Three deaths after spontaneous abortions and 2 deaths after legal abortion were recorded during the 1970s, 4 of them due to sepsis (VIII).

Hemorrhage deaths, such as ectopic pregnancy, placenta praevia and ablatio placentae, had their greatest mortality reduction during the 1940s and 1960s (Table I).

Although eclampsia mortality was halved from 1931-35 through 1946-50, this diagnosis became the prime cause of maternal mortality during the 1940s. Mortality dropped by 74% during the late 1950s, and by an additional 54% during the 1960s (Table I). Twelve deaths from pre-/eclampsia were recorded during the 1970s, 5 of them due to pathological proteolysis, while the others due to cerebral, cardiac or respiratory complications (IX).

The reduction of obstructed labor mortality started during the late 1940s, and continued to decline, together with mortality from uterine rupture, decisively until the 1960s (Table 1). Only 4 patients died of obstructed labor during the 1970s; all of these had uterine rupture, 3 spontaneous and 1 after an earlier cesarean section (IX).

The mortality of amniotic fluid embolism remained fairly stable during the years 1951-1980, but the relative importance of this death cause has increased. During the first 5-year period, only 1.2% of the maternal deaths were ascribed to amniotic fluid embolism, whereas during the last decade this syndrome accounted for 16.5% of the maternal mortality (Table 1, VII).

Mortality from venous thrombosis with pulmonary embolism, arterial thrombosis and air embolism declined especially during the 1950s and early 1960s. The last cases of air embolism during delivery occurred in the early 1960s (V). 10 fatal cases of thrombo-embolic disease were observed between 1971 and 1980, accounting for 15% of maternal mortality.

Mortality from cesarean section decreased during the 1950s and the early 1970s, but increased during the late 1960s and 1970s, concomitantly with an increased cesarean section rate. The mortality risk ratio of abdominal delivery versus vaginal delivery was 10 (460.8/47.3) for the years 1951-55, and increasing to 13 (52.5/3.8) for the years 1976-80. The corrected risk ratio (moribund before the operation excluded) was 9 (34.4/3.8) during the last period, while the mortality for complications attributed solely to the surgical procedure was 6 (23.5/3.8). Fatal complications attributed to the surgical procedure accounted for 19% of maternal mortality during the 1970s (VIII).

The decline in maternal mortality levelled out during the 1970s (Fig.1, Table I). Amniotic fluid embolism, pulmonary embolism and hemorrhage were the

Table I. Incidence per 1,000 live births, cause-specific mortality per 100,000 live births, and case fatality rate per 100 diagnosed cases or procedures in Sweden 1861-1980

Death cause	Period 1861-80	1881-1900	1931-35	1936-40	1941-45	1946-50	1951-55	1956-60	1961-65	1966-70	1971-80
Puerperal sepsis											
The seven parishes											
mortality	88.7	32.7	-	-	-	-				-	-
Lying in Hospitals											
incidence	54.3	2.3	-	-	-	-	-	-	-	-	-
mortality	2701.0	95.9	-	-	-	-	-	-	-	-	-
fatality	57.0	42.0	-	-	-	-	-	-	-	-	-
Sweden											
mortality	258.0	210.0	93.4	62.0	15.6	3.5	1.8	2.3	0.2	1.0	0.3
Abortional sepsis											
mortality	-	-	75.4	51.8	31.8	5.2	-	-	-	-	-
Illegal abortions											
mortality	-	-	-	-	-	-	2.8	2.3	1.1	0.5	0
Legal abortions											
mortality	-	-	-	-	-	-	2.6	0.6	1.1	0.7	0.4
fatality	-	-	-	-	-	-	-	-	-	-	0.001
Ectopic pregnancy											
mortality	-	-	6.6	7.7	7.1	3.0	2.6	1.1	0.9	0.2	0.4
Eclampsia											
Lying in hospitals											
incidence	2.1	2.9	-	-	-	-	-	-	-	-	-
mortality	85.6	58.7	-	-	-	-	-	-	-	-	-
fatality	42.0	20.0	-	-	-	-	-	-	-	-	-
Sweden											
incidence	-	-	-	-	-	-	1.06	1.25	0.77	0.45	0.22
mortality	-	-	51.2	50.7	38.2	26.4	15.5	4.0	3.7	1.6	0.7
fatality	-	-	-	-	-	-	13.9	2.4	3.0	2.2	3.1
Placenta previa											
mortality	-	-	17.9	20.1	11.9	5.9	2.0	1.3	0.7	0.2	0.2
Placenta previa/ablatio placentae											
incidence	-	-	-	-	-	-	-	7.9	7.6	5.3	8.1
mortality	-	-	-	-	-	-	4.2	3.7	1.1	1.0	0.2
fatality	-	-	-	-	-	-	-	0.4	0.1	0.2	0.2
Obstructed labor											
mortality	-	-	20.6	35.7	26.0	13.2	8.2	5.4	2.8	1.7	0.5
Uterine rupture											
Lying in hospitals											
incidence	0.4	0.1	-	-	-	-	-	-	-	-	-
mortality	24.7	2.9	-	-	-	-	-	-	-	-	-
fatality	60	34	-	-	-	-	-	-	-	-	-
Sweden											
incidence	-	-	-	-	-	-	-	0.34	0.58	0.42	0.25
mortality	-	-	-	-	-	-	4.5	2.8	1.1	0.7	0.5
fatality	-	-	-	-	-	-	-	8.3	1.8	1.7	1.9
Post-partum hemorraghe											
mortality	-	-	-	-	-	-	2.8	2.3	0	0.5	0.4
Amniotic fluid embolism											
mortality	-	-	-	-	-	-	0.6	1.3	1.9	1.6	0.8
fatality	-	-	-	-	-	-	-	-	-	-	66.0
Trombo-embolic disease											
mortality	-	-	-	-	-	-	3.9	1.9	1.4	1.0	1.0
Cesarean section											
incidence	-	-	-	-	-	-	17	18	19	31	110
mortality	-	-	-	-	-	-	8.6	6.2	3.1	3.7	3.8
fatality	-	-	-	-	-	-	0.5	0.35	0.2	0.1	0.06
Maternal mortality (total)	426.0	215.0	326.0	260.1	158.9	77.8	60.0	33.7	18.6	12.6	6.6

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main causes of death within 24 hours after delivery, while pre-eclampsia and sepsis were predominant during the following days of the puerperium (IX).

Predisposing, positive, risk factors

There is a positive correlation between a high total mortality in the community and high maternal mortality (I).

Marital status, birth interval and occupation were risk factors of no statistical significance in the seven parishes. However, the data are sparse (II). During the 1950s unmarried women had a mortality of 63.2, while married women had a mortality of 42.5. This difference was eliminated during the early 1960s.

Unwanted pregnancies

Unwanted pregnancies were an important risk factor during the 20th century. The peak in septic abortional deaths during the 1930s coincided with the greatest reduction in birth rate, a fertility of 1.7 children per woman, when legal abortion was not available and the sale of contraceptives was forbidden (VI). The concept of preventability on behalf of the woman and existing legislation imply deaths from unwanted pregnancies. 11% of maternal deaths between 1951 and 1980 followed unwanted pregnancies (V). Between 1971 and 1980, 6 of the maternal deaths followed an unwanted pregnancy. The death causes were septic spontaneous abortion, legal abortion, pre-eclampsia, and third stage hemorrhage during domiciliary delivery together with infanticide (IX).

Age and parity

Age but not parity was found to be a significant factor of maternal mortality in the seven parishes during the 19th century. Women aged 15-29 years with a parity of 2-3 ran the least risk of dying in connection with childbirth. Women aged 40-49 had a 2-fold increased death risk during the 19th century (II), while there was a 23-fold mortality risk in the same age interval during the 1970s (IX). There is an interaction between age and parity. The older primiparous group had a 3-fold increased mortality risk during the 19th century, and

7-fold during the 1970s (IX). The etiologic fraction, maternal deaths due to the increasing risk of age and parity, was 46% during the 19th century, but increased to 77% between 1951 and 1980 (IV).

High risk

Risk elements, pre-existing diseases or conditions before gestation, had been present in 27% of the cases during the 1950s, while this figure increased to 46% during the 1970s (V). Six of the patients dying during 1970s had intercurrent diseases such as heart diseases, diabetes mellitus and renal disease. The 2 patients dying of septic abortions in the second trimester had previously undergone conization of the cervix (IX). The proportion of additional risk elements, complications appearing during pregnancy, has been stable during the years 1951-80 at 34% (V). Conditions predisposing to amniotic fluid embolism were identified as gemini/polyhydramnios, abruptio placentae, hypertonic labor, rupture of the birth canal, macrosomia, and obstetrical interventions such as administration of oxytocin and pressure applied to the fundus (VII).

Medical Technology

Adverse effects of medical technology are predisposing, positive, risk factors. Lying-in hospitals before the introduction of antiseptic techniques were a positive risk factor in the transmission of puerperal sepsis. Given the mortality rate of puerperal sepsis for 1881-95, after the introduction of antiseptic techniques, the number would have been 119 instead of 1,720 between 1775 and 1900. The difference, 0.15% of all maternal deaths in Sweden during the years 1775-1895, is a measure of the potentially adverse effects the lying-in hospitals had on the maternal mortality rate. However, the protective effect of the lying-in hospitals as education centers for midwives and physicians practising in rural areas has not been considered.

The increased mortality of abdominal delivery versus vaginal delivery can be termed a positive risk factor. The increase in the cesarean section rate from 4.9% to 11% during the 1970s had a potential impact of 23% on maternal mortality between 1976 and 1980 (VIII).

Possible avoidability of maternal deaths implicates elements of professionalism. In 40% of maternal de-

aths occuring during the 1950s the outcome could have been different if the interventions to deal with the pregnancy and delivery complications had been different. This figure dropped to 25% during the 1970s (V). In most cases the avoidability was on behalf of the obstetrician, with delayed diagnosis of hepatic necrosis, uterine rupture, pulmonary embolism and peritonitis (VIII).

ternal age. The effect of the parity factor is the converse, but is negated by the combined impact of age/parity (IV). The age factor contributed 10-30% of the decline in mortality due to hemorrhage, pre-eclampsia/eclampsia and obstructed labor during the last 40 years (V). Furthermore, 20% of the cesarean section mortality decline could be attributed to the age preventive factor between 1951 and 1980 (VIII).

Protective, negative, risk factors

Age and parity

The changed distribution in the age of the parturients, i.e. a smaller proportion of parturients of advanced age (Fig. 3), contributed 2.9% of the mortality decline between 1781 and 1911, and 4.7% between 1911 and 1980. Indeed, during the last 15 years, about 50% of the mortality decline has been due to decreasing ma-

Medical Technology

The antiseptic technique reduced septic maternal mortality 25-fold in lying-in hospitals and 2.7-fold in domiciliary deliveries between 1881 and 1900, i.e 63% of septic maternal deaths were "prevented". Licensed midwives assisting domiciliary births reduced non-septic maternal deaths 5-fold between 1861 and 1900, i.e. 46% of non-septic maternal deaths were "prevented" (Fig. 4). These results may be biased by the small sample of the seven parishes, but the definite tendency is not altered - assuming other relative risks (III).
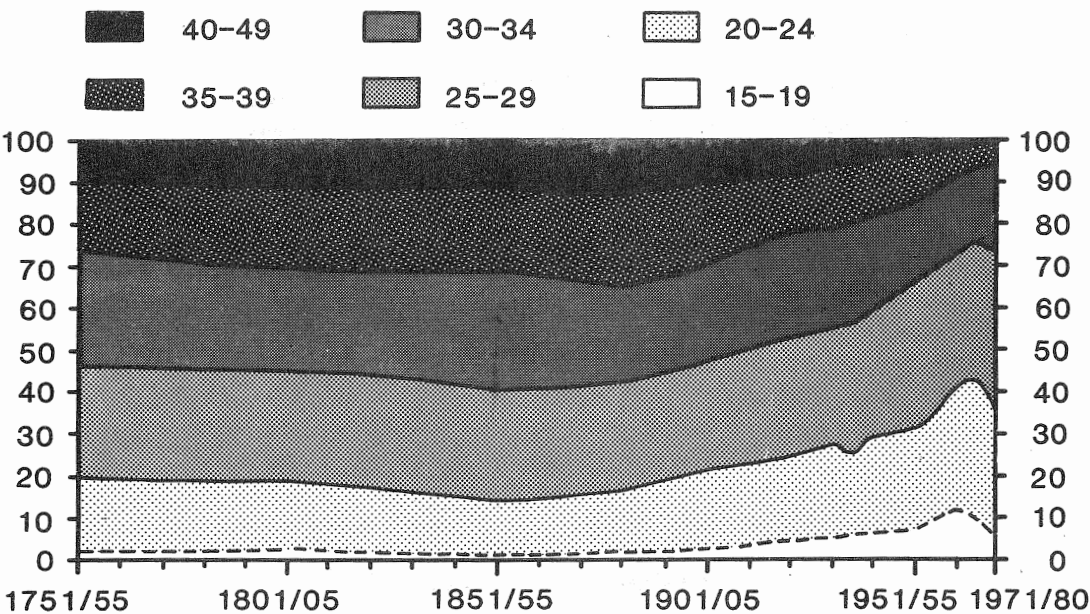
Fig. 3. Percentage of deliveries by age of the women in Sweden between 1751 and 1980, five year mean.

15

Berättelse om en Instrumental-
förlossning år 18*86*

1.379.

En gift qvinna, vid namn *Johanna Öhlen*
boende i *Tuna Socken* bynamnet *Öhn*
26 år gammal, af en *Medel stor* kroppsbyggnad, *1* gången haf-
vande, hade börjat känna förlossningsplågor kl. *7* efter-midd. d. *10 Augusti*

Vid min ankomst kl.*9/11* för-efter-midd. d. *11 f. m. d*
befann jag bäckenet *Wälbildat.*
modermunnen *utplånad . . . .* himmorna brustne-brustne
Fostrets läge:*) *Högra hörngropsviddens framstupade*
Kronbjudning hufvudet war wänt med pannan bak åt högra
hörngropen, och nackspetsen fram åt minstra blygdbenet.
Och som wärkarna woro Starka och täta och
Fostret stot i 6 timmar utan att skrida.
i nedre Bäckenet.

så ansåg jag mig böra komma naturen med instrumenter till hjelp,
och tillgrep derföre kl. *12* för-efter-midd. d. *11 denne* *Tången*

hvarmed jag, efter *1/2* timmars arbete, utskaffade ett

lefvande gosse-döde- flicke-barn, som vägde *9* skålpund ~~ort.~~ Qvinnan har

blifvit till helsan återställd.
aflidit på dagen efter förlossningen.

Elisabeth Holmgren Barnmorska i *Tuna Socken i Medelpad*

Såsom vittnen voro vid förlossningen närvarande:

Fru. Langejus *Signé Tunberg*
Alfred Öhlen
Berättelsen afsändes till Doktor *Söderbaum* den *12 Augusti* 18*86*

———
*) Fosterlägets benämning utsättes fullständigt,
t. ex. Högra hörngropsviddens vidöppna kronbjudning;
» Venstra hörngropsviddens framstupade sätesbjudning;
» Högersidig tvärriktning med fötterna i qvinnans venstra sida, o. s. v.

16

The existing material did not admit an epidemiological analysis of the potential impact of antibiotics, antenatal and obstetric care over the last 40 years. However, excluding the age factor, the incidence and mortality of certain pregnancy and delivery complications imply a possible impact of medical technology. Furthermore, fatality rates mainly reflect the standard of obstetric care. Prevention of maternal deaths had its greatest success concomitantly with the emergence of modern obstetric care (I).

Mortality from puerperal sepsis and abortional sepsis had a sharp drop associated with the introduction of sulphonamides and penicillin (V). Placenta praevia mortality was reduced during the 1940s when blood transfusion became a clinical routine (Table I). Hemorrhage mortality was further cut by 92% during the 1960s, when the incidence of antepartum hemorrhage was unchanged but the case fatality rate was halved (Table I). The decline in obstructed labor mortality was also mainly due to better obstetric care with a sharp drop in the case fatality rate. The incidence of eclampsia remained unchanged during the 1950s, but the case fatality rate was cut to one-sixth. During the subsequent decades the case fatality rate remained unchanged, while a falling incidence was responsible for the mortality decline (Table I). Furthermore, the cesarean section mortality decline was mainly due to the reduced case fatality rate (Table I, VIII).

The impact of antenatal care on mortality cannot be evaluated retrospectively. The early detection of pre-eclampsia and iron supplementation may have been important contributory measures (V).

The elimination of domiciliary and cottage hospital deliveries, with which had high levels of maternal mortality during the 1950s and 1960s, might partly account for the reduction in national maternal mortality during recent decades (V).

Legislation and liberal abortion practice eliminated illegal abortions and altered the distribution of legal abortions to more favorable timing by pregnancy week. This, together with new abortional techniques, caused a 50-fold drop in legal abortion mortality, at the same time as the number of legal abortions increased 7-fold (VI).

DISCUSSION

The reliability on statistics of maternal deaths can be questioned. From Africa and Asia there is information about age, sex and cause of death for only 10% of the populations; from Latin America for 50% (Fig. 5, 11, 16). Most of the studies on maternal mortality in the developing countries are based not on community data but on hospital data (18,84). Community studies report higher rates than hospital studies (15,17,18).
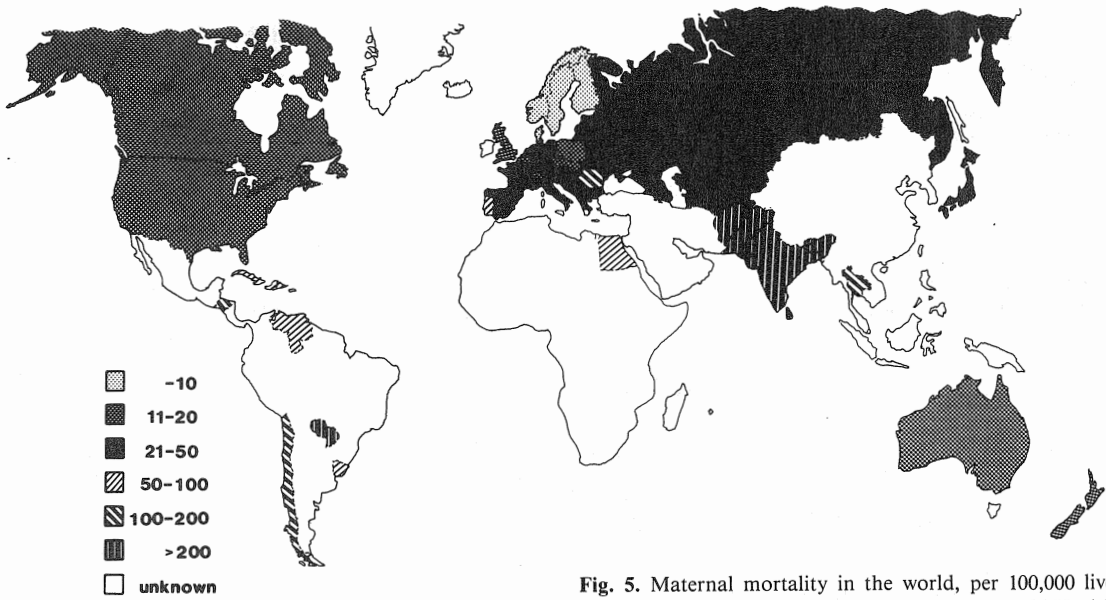

-10
11–20
21–50
50–100
100–200
>200
unknown

Fig. 5. Maternal mortality in the world, per 100,000 live births, indirect maternal deaths are excluded (World Health Statistics, 1982).

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The present secular analysis of a single death cause includes sources of error. The Swedish national statistics on maternal mortality in the 18th and 19th centuries could be underestimated by 30% of the true extent (II). Furthermore, deaths from abortions and ectopic pregnancies were probably not included in the statistics for the 18th and 19th centuries. They constituted 15% of maternal deaths between 1931 and 1980 (V). However, abortional deaths are mainly a phenomenon of the 20th century (VI). Indirect maternal deaths could have been reported as direct maternal deaths in earlier centuries (I,II), but this bias is also present in the death cause statistics during the years 1971-80 (IX).

Even maternal mortality figures in the developed countries are a matter of debate (21,84,86). The usual source for international statistics are the aggregated death cause statistics from each country. In addition to official statistics, death certificate surveillance revealed 13% more maternal deaths in Sweden between 1971 and 1980 (IX). Death certificates matched with birth certificates revealed 27-113% more maternal deaths than routine death certificate surveillance (84,86). On the other hand, however, the Swedish Medical Birth Registry dectected fewer cases than were found by death certificate surveillance (IX).

The maximum time interval of 42 days after delivery defined for maternal death could also conceal further risks associated with childbirth. From the U.S.A. and Great Britain respectively, 50% and 13% respectively increases in maternal deaths are reported when the time interval is not restricted to 42 days (82, 84). In the seven Swedish parishes a minimum increase of 27% was detected with an interval of 1 year (II). High maternal mortality in any society also influences mortality in older women of non-reproductive ages (39). The problem of maternal mortality in the world could therefore be even more serious than concluded in official reports.

Impoverished conditions

Mortality is strongly influenced by environment and cultural behavior. Poverty, malnutrition, arduous work, low status of the woman and high infectious morbidity heighten the mortality risk of childbearing (10,35-38). In Bangladesh, Ceylon, India and Pakistan a higher female than male mortality in the reproductive ages indicating a high maternal mortality (7,15,17,87). No comparable regional or national data are available from other parts of the third world (11,16). Similar levels of regionally high maternal mortality as above are known from Nigeria and Papua New Guinea, implying patterns of excess female mortality in reproductive ages even in other parts of the third world (88,89). However, from Malawi and Uganda a lower regional maternal mortality is estimated (90,91).

Maternal mortality is responsible for about 25% of all deaths in the reproductive ages in the developing countries (92). In the most active ages the percentage could be as high as 34-57% (15), which is comparable to the Swedish 19th century figures (II). The severe demographic consequences of a maternal death in a poor society is illustrated by the extremely high cumulative death risk of orphans in the 19th century Sweden, which, extrapolated to the developing countries of today exposes several millions of abandoned children every year to malnutrion and consequent death (93).

Anemia is one of the most widespread deficiency diseasis, exacerbated by malaria and hemoglobinopathies, in the whole world. Women of reproductive age more often have serious anemia than men do (10,94-96). About 40-50% of maternal mortality is associated with serious anemia (10). Eclampsia fatality is 5-fold higher when the hematocrit falls below 30% (97). Defence mechanisms against infections are not entirely intact during pregnancy due to suppressed cell mediated immunity. This, in combination with anemia, brings about a higher indirect maternal mortality comprising deaths caused by diseases such as ameboid dysentery, shigellosis, malaria, typhoid fever, pneumonia, tuberculosis, hepatitis and impaired wound healing (96,98-100). Indirect deaths comprise 14-30% of fatalities in obstetrical departments of Africa today (83), comparable to the Swedish 19th century (II). Impoverished living conditions must therefore have been one of the main causes of the high maternal mortality through history. Even with modern obstetric technology, maternity departments in Africa today have a mortality rate as high as in the Swedish lying-in hospitals of the late 19th century, thus indicating the serious socio-economic deprivation which determines the health of pregnant women in developing countries (83).

Historical background

It has been stated that the hazards of childbirth were less onerous in prehistoric communities than they were to become Europe during the 18th and 19th centuries with the horrors of rickety pelves and puerperal fever (101). On the other hand, archeological life table analysis of the medieval Sweden shows a higher female than male mortality in reproductive ages. This excess female mortality cannot be reproduced from the national statistics of 18th century Sweden, which implies higher maternal mortality in the Middle Ages (102). Nor was excess female mortality found in the seven Swedish parishes (II). The reversal of sex-differences in mortality may well be a latter-day cultural phenomenon in other parts of Europe. Excess female mortality was reported during the 17th and 18th centuries in England (103), and during the 19th century in Germany (104), and France (105).

The earliest community data on maternal mortality come from 16th century London, with a rate of 2,350 per 100,000 births (106). By family reconstitution technique, mortality rates of 1,000 - 2,800 have been reported from England, Germany and France during the 17th-19th centuries (107-110). Mortality rates of 2,000 during the 19th century have been found in parishes in Finland due to impoverished living conditions (40). Those figures are higher than the Swedish mortality data for the 18th and 19th centuries (I). Even if the national data underestimate the true extent of maternal mortality, the information from the seven parishes does not indicate a level as high as in other parts of Europe (II). The data rather suggest that Sweden had a lower proportion of maternal deaths during the 18th and 19th centuries. This, together with the different sex-specific mortality pattern in Sweden, could indicate a better status for peasant women in Sweden than in other European countries.

Obstructed labor

Rickets, general undernourishment during childhood, and osteomalacia give rise to contracted pelves with increased risk at childbirth (3,96). Prolonged/obstructed labor is one of the chief causes of high intrapartal mortality in Indonesia (27). Difficult labor was one of the main causes of direct maternal deaths in the seven Swedish parishes (II). The mortality of obstructed labor was still as high in Sweden during the 1930s as in the lying-in hospitals of the late 19th century (IV,V). Definite improvements in the nutritional status of children were achieved from the 1920s onward (111). This cohort started their reproductive life during the 1940s, when a reduction in the incidence of contracted pelves was observed (112).

Puerperal sepsis

Fatal puerperal sepsis was the ultimate common path of contracted pelves, anemia and high contemporary susceptibility to the streptococci (113,114). Puerperal sepsis has a 25-30-fold higher fatality in anemic women (10). Due to the epidemics it was questioned whether the lying-in hospitals were of any benefit to women (115). However, their relative importance the high maternal mortality in the obstetric history has been exaggerated, as shown in the present study. Rather, the main problem of puerperal sepsis prevailed in the rural areas (IV). After the introduction of antiseptic technique, puerperal sepsis mortality did not decline further until the 1930s (50,IV,V).

Prevention of maternal deaths

Although improvement in the environment and nutritional state leads to a lower maternal mortality, the decline in maternal mortality has other, strange, determinants than the general improvement in socio-economic standards. The better standard of living of the ruling families of the Ancien Regime in Europe did cause lower infant mortality - but not a lower maternal mortality than among the general population (52). The high maternal mortality of the royal families could be compounded by obstetrical malpractice and high parity of the women. Avoidance of modern obstetric care in the U.S.A. increases the mortality risk 100-fold (51) to rates equalling or exceeding those of the developing countries. The data from this study indicate that the factors affecting the decline in maternal mortality in Sweden were much more effective than those controlling total, infant, male, female, and tuberculosis mortality (I). Especially pronounced was the decline in the late 19th century when the authorities campaigned to prevent maternal deaths (63,116,117), and then during the emergence of modern obstetrics (V).

The majority of maternal deaths in developing co-

untries today can be prevented (88,89,91,118-120). A lack of antenatal care increases the risk of death 10-fold. Women who are admitted in an emergency with labor complications and who have had no earlier antenatal care, run the biggest risk of dying (121-128). On the other hand, a sizeable proportion of maternal deaths, 20-40%, had no recognizable risk factors before gestation or during pregnancy in Sweden 1951-80 (V). This proportion is probably higher in areas with high maternal mortality (129-131). Most fatal complications, such as hemorrhage and obstructed labor, cannot be averted by preventive measures such as screening during antenatal care. The concept of primary health care needs widening, so as to include maternity care, in order to have an impact on maternal mortality (92).

The experience of the rural midwife service at domiciliary deliveries preventing non-septic maternal deaths in Sweden, could be of interest to developing countries today, as there is a trend to train and cooperate with traditional birth attendants (132,133). However, increasing the competence of the assistance at domiciary deliveries and imposing antenatal screening, are of no value without maternity referral centres which can deal with such complications as hemorrhage, obstructed labor and pre-/eclampsia (92). The high mortality rate of the obstetrical departments in developing countries is multifactorial. Besides patient's delay, lack of antenatal care and intercurrent diseases, very trying conditions in the hospitals, e.g. overcrowding, poor nursing care, doctor's delay, lack of technical and laboratory facilities - all contribute to the high death rate (119,120,122,126). The setting up of maternal mortality committees is a necessity in the developing countries (83,127,134).

The success of the Swedish rural midwife service is probably one explanation why Sweden had a lower maternal mortality rate (I) than more prosperous countries such as Britain and the U.S.A. in early the 20th century (49,135). A phenomenon common to the industrialized countries during the first decades of the 20th century was that total mortality declined, whereas maternal mortality remained stable or even increased.

Abortions

The increase in illegal abortions was the reason why maternal mortality did not decline during the first decades of the 20th century (VI). Illegal abortion is no-wadays a worldwide problem. Deaths from both induced and spontaneous abortion account for 3-70% of hospital-related deaths in the developing countries (136). Of the estimated 35-55 million abortions annually induced throughout the world, about half are illegal (136). The fatality rate of illegal abortions is estimated at 50-1,000 per 100,000 procedures (6,137). At least 90,000 women die annually from abortion in the developing countries (137).

The abolition of illegal abortions in Sweden took decades, with changes of legislation and hospital practice for legal abortions (138). The positive health benefits of liberalizing of abortion laws and practices is confirmed from the U.S.A. (139-143), Bangladesh (144), Singapore (145). The fatality rate of legal abortions in Sweden is now lower than reported from the U.S.A. (146).

20th century medical technology

The high or even increasing maternal mortality in industrialized countries during the 1930s was a matter of concern. In the U.S.A. and Britain, efforts to prevent maternal deaths were organized through maternal mortality committees, which initiated improvements in antenatal and obstetric care. Their work has been hailed as one of the chief factors responsible for the mortality decline (24,81,147), though this has been questioned (148). Maternal mortality has declined exponentially during the last decades (6,11,16,44,149).

At least 75% of obstetric deaths in the developing countries are caused by hemorrhage, infection, pre-eclampsia/eclampsia and obstructed labor, just as they were in the industrialized countries 50 years ago (XI). The reduction of maternal mortality is mainly an achievement of medical technology. The epidemiological control of streptococci followed by the introduction of sulphonamides and penicillin caused a sharp drop in the incidence and fatality of puerperal sepsis in the 1940s (41,42,150-153). The fatality reduction of eclampsia coincided with an improved knowledge of the disease and correct intensive care of the critically ill pre-eclamptic patient (48,154,155). The reduction of anemia by adequate antenatal care, combined with the development of blood transfusion technique, is the principal explanation for the decline in hemorrhage deaths (6,48,15,156). Oxytocin therapy has facilitated the solution of some difficult obstetric problems, and cesarean section has replaced a number of dangerous manipulations (48).

Age as a positive risk

The risk of age is described as J- or U-shaped with a 2 to 6-fold risk increase from the optimal age interval (10,26,27). The increased mortality risk of teenagers has been eliminated (27). However, the relative importance of age as a determinant of maternal mortality has increased from the period of high mortality to the present low mortality in Sweden (IV). This is consistent with the trend for increasing age to be one of the most difficult risk factors to overcome in maternal mortality in developed countries (19,27,155,157).

Family planning

Family planning involves a change in the distribution of the parturients by age and parity. Earlier studies from Australia (31), and Scotland (34) could not ascertain a relationship between a shift in age and parity or birthrate and maternal mortality. However, in reports from the U.S.A. (32) and the Netherlands (33) a definite influence on the mortality rate is ascribed to family planning. The present study is the most conclusive regarding shifting age and parity as causative in the decline in maternal mortality. The effect was less pronounced in the period of high mortality, but has become one of the principal factors behind low mortality (IV).

If effective contraceptives were available to all women requiring them, then it is estimated that maternal mortality would be reduced substantially: by 15% in Subsaharan Africa, 40% in Sri Lanka and Pakistan (92), and by 30% in Bangladesh (15).However, it should be considered that the positive effects of family planning on maternal mortality could be negated by adverse health effects. During the 1930s and 1970s Sweden attained its lowest birthrate on record, 1.7 and 1.6 births per woman respectively. Illegal abortions caused 23%, 593 deaths, of maternal mortality during the 1930s, while oral contraceptives were associated with 20%, 20 deaths, of reproductive mortality during the 1970s (158).

1970s

The Scandinavian countries have reached one of the lowest maternal mortality rates in the world (12,19). In the U.S.A. 0.5% of all deaths are maternal deaths among women aged 15-49 (159), in Sweden the percentage if half of that figure (I). The maternal mortality rate in Scandinavia levelled off during the 1970s (19). The death causes in modern obstetrics have changed - less than half the cases are attributed to pre-eclampsia/eclampsia, hemorrhage, infections and obstructed labor (19,160). The main difference in comparison with 50 years ago, is the relative importance of amniotic fluid embolism and other thrombo-embolic disease during the 1970s with a low probability of avoidability (24,161). Another change is the relative importance of cesarean attributed mortality during the late 1970s (162,163). The high percentage of avoidability of maternal deaths still reported from the U.S.A., Great Britain and Australia (23-25) could not be reproduced from the Swedish cases during the 1970s (IX).

Positive risk factors of maternal deaths as unwanted pregnancies, advanced age of reproduction and suboptimal standard of antenatal and obstetric care still contribute to the present maternal mortality picture in Sweden, suggesting that family planning and improvements in obstetric care could further reduce maternal mortality. The importance of surveillance of maternal deaths is strengthened by British experience of the Confidential Enquiry into Maternal Deaths, where mortality was halved during the 1970s, reaching a level equal to the Scandinavian countries (164).

The question now is whether the plateauing of the maternal mortality represents an irreducible minimum, or whether it is still possible to bring these figures down to another bottomline. The best answer to this question is a quotation from Dr J.B. Lawson: "The aim in any obstetric unit, should be to reduce the mortality, from obstetric causes to nil, as there should be no wastage of maternal lives in a physiological process of reproduction" (119).

CONCLUSIONS

1. Maternal deaths accounted for 10% of female deaths in the reproductive ages during the 18th century. However, among women in the most active childbearing ages maternal deaths accounted for 40-45% of female deaths. Of the motherless children under the age of 5, only a small minority survived.
2. Indirect maternal deaths comprised a sizeable proportion of maternal deaths in the 19th century. Puerperal sepsis caused half of the deaths in the national statistics during the second half of the 19th century,

while puerperal sepsis in the lying-in hospitals accounted only for a minor proportion of deaths.

3. Maternal mortality has declined 150-fold during the study period of 230 years, especially during the late 19th century and the last 40 years.

4. The midwife service in rural areas and antiseptic techniques were the single important preventive interventions in reducing maternal mortality during the 19th century.

5. A gradual shift in the distribution of age and parity amongst the parturients had a considerable impact on the mortality decline. The effect has been especially pronounced during the last 15 years (1965-1980), contributing to 50% of the mortality decline. Hence, the age factor is part of the mortality decline by death cause.

6. Maternal mortality has declined exponentially during the last 40 years. The decline in cause-specific mortality and the case fatality rate of pregnancy and delivery complications is associated with the emergence of modern medicine - antibiotics, antenatal and obstetric care.

7. Illegal abortion was a health problem during the early 20th century, but has been abolished by legislation and changed hospital practices. However, unwanted pregnancies still account for a portion of maternal mortality.

8. The mortality decline levelled out during the 1970s. Advanced age and intercurrent diseases are the most difficult risk factors to overcome. The percentage of avoidable deaths has declined during the last 30 years. The distribution of death causes has changed, with a declining proportion of deaths from such causes as hemorrhage, pre-/eclampsia, obstructed labor and infections, while the relative proportion of amniotic fluid embolism and other embolism is increasing. During the 1970s maternal deaths only accounted for 0.2% of the female deaths.

9. To conclude, the study indicates that the reason why maternal mortality has declined faster than other health indices is that most maternal deaths can be prevented by appropriate medical technology, including family planning, and antenatal and obstetric care. This experience should be of interest to the developing countries where high maternal mortality prevails.

ACKNOWLEDGEMENTS

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