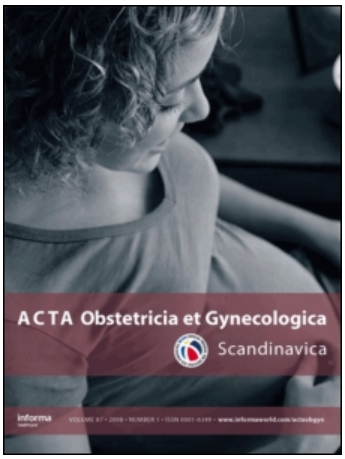

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ORIGINAL ARTICLE

Direct maternal deaths in Norway 1976–1995

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Abstract

Aims. To report direct maternal mortality ratio (MMR) in Norway between 1976 and 1995 including a description of the underlying complications in pregnancy, the causes of death and assessment of standard of care. *Methods*. The maternal deaths were identified through the Cause of Death Registry, Statistics Norway, and Medical Birth Registry of Norway. We requested copies of the hospital case records and the maternal death autopsies. The direct maternal deaths were classified on the basis underlying causes and assessed for substandard care according to the guidelines at the time of death and preventability provided optimal conditions and up to date guidelines. *Results*. In the period 1976–1995 we identified 61 direct maternal deaths in Norway. The direct MMR was 5.5/100,000 births. Sufficient information was available for analysis in 51 of these cases. Six deaths occurred in early pregnancy. Among the 45 women who gave birth, 32 had a cesarean section, and the death was judged to be related to a complication of the operation in more than half of these cases. The standard of care and the possibility of preventing death were evaluated in 49 cases. Substandard care was observed in 21 of them and 27 were considered avoidable or potentially avoidable. *Conclusion*. The direct MMR in Norway was 5.5/100,000 births. The main causes were complications of hypertensive disease of pregnancy and thromboembolism. The majority of maternal deaths were associated with cesarean delivery and considered potentially avoidable.

Key words: *maternal deaths, underlying causes, substandard care, Norway*

Introduction

Maternal death in Europe is a rare event and even inconceivable to most people. The maternal mortality ratios (MMR) in European countries are low compared to that in developing countries (1–6). In the UK, France and the Netherlands, where confidential inquiries into maternal deaths have been performed regularly, 40–66% of the direct deaths are shown to be associated with substandard care (7–10). The "Confidential Enquiry into Maternal and Child Health 2000–2002" from the UK reports that maternal deaths often occur because the actual condition is not diagnosed or the women receive ineffective or erroneous treatment. They also found that clinical guidelines were not followed, experienced staff was not involved, and poor or even absent communication between the staff members was observed (9). In the same report they underline the importance of observational studies to identify patterns of practice and services provided about rare, but important, complications that may be causally related to maternal deaths. The World Health Organization (WHO) has also published an audit manual to better understand and learn from these tragic events (11). An investigation and comparison of maternal deaths and severe obstetric morbidity can provide insight into how to better handle obstetric emergencies (12–14).

The aim of the present study is to identify and audit direct maternal deaths in Norway that occurred during 1976–1995, to classify them according to the underlying causes of death and evaluate the standard of care and preventability.

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Material and methods

The maternal deaths were identified through the Cause of Death Registry, Statistics Norway and the Medical Birth Registry of Norway (MBRN). The WHO and the tenth revision of the International Classification of Diseases (ICD-10), define a maternal death as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (15). The subgroup of early pregnancy deaths includes deaths following induced abortions, miscarriages and ectopic pregnancies. Direct obstetric deaths are deaths resulting from obstetric complications of the pregnancy, from interventions or incorrect treatment. Indirect obstetric deaths are caused by other conditions that are aggravated by the pregnancy. A valid estimate of the direct and indirect maternal mortality rates requires information about all deaths of women of reproductive age, the cause of death and whether the woman was pregnant at the time of death or had recently given birth or terminated a pregnancy.

In the present study, we categorized the maternal deaths according to the underlying cause, i.e. the disease or the complication that started the cascade of events leading to death. The hospital case notes were reviewed by the two Norwegian authors – both obstetricians. A registration form designed for this study was completed for each case, covering sociodemographic characteristics, medical and obstetric history, mode of delivery, complications during pregnancy and delivery and in the puerperium, the circumstances surrounding the death, results from autopsy, and fetal outcome.

The quality of care was evaluated by audit by the authors based on in-depth investigation of the case records. Each case was evaluated according to predefined criteria for substandard care: (1) the patient was not examined adequately considering the symptoms presented; (2) the patient was not treated with antihypertensive drugs despite blood pressures of $>160/110$ mmHg on repeated measurements; (3) the maternal death was due to inadequate anesthesiological management; and (4) the treatment was not according to the accepted guidelines or the woman was not seen by specialists from other medical disciplines when needed.

If the woman did not follow the recommended treatment it was categorized as substandard self-care, if not referred to hospital with serious complications in pregnancy as substandard antenatal care, and if hospitalized patients were not examined or treated according to the common standard of care at the time of the death as substandard hospital care.

Each case was also assessed with reference to its preventability. The deaths were categorized as unavoidable, potentially avoidable and avoidable considering the treatment, national guidelines and procedures of today (16).

The MMR is the number of maternal deaths per 100,000 live births. Data on the total number of births, live births, cesarean sections and the number of births at different maternity units during 1976–1995 were obtained from the annual reports of the MBRN (17). Analyses were performed using SPSS, statistical package for Windows version 14.0 (SPSS Inc, Chicago, IL, USA). The study was approved by the Regional Committee for Research Ethics and the Norwegian Data Inspectorate.

The fatality rate for cesarean deliveries is expressed as the number of deaths per 1,000 performed operations (18). The risk attributable to cesarean delivery is difficult to assess, because it is associated with severe chronic or intercurrent diseases and pregnancy complications. Therefore, we have assessed if the death was attributed directly to the operative procedure.

During 1976–1995, there were 1,100,831 live births in Norway and we identified 61 direct maternal deaths from the Cause of Death Registry and the MBRN. These registers report the ultimate cause of death. In 51 cases we received photocopies of the hospital case records and 45 included autopsy reports. In 10 cases we were not able to retrieve case records in spite of repeated requests to the departments. The case records were reported to be impossible to find or to have disappeared.

Results

A total of 61 direct maternal deaths were reported in the period 1976–1995. The annual average number of direct maternal deaths in Norway was three (range 0–7). There were 36 primiparous and 25 multiparous women, and 15 mothers had three or more previous deliveries. The MMR for direct maternal deaths was 5.5/100,000 live births. In the first 10 years, the MMR was 5.6/100,000 live births and in the last 10 years the MMR was 5.4/100,000.

The descriptive analyses of cases are based on information from the 51 case records received. Ten patients had chronic diseases that might complicate the pregnancy, such as autoimmune diseases ($n=3$), severe obesity (BMI >35)($n=3$), previous thromboembolism ($n=2$), chronic hypertension ($n=1$) and complications after poliomyelitis ($n=1$). Thus,

41 of 51 women were considered low risk before pregnancy.

Time of death

There were six early pregnancy deaths (6/51). For the remaining 45 women, the median gestational age at delivery was 38 weeks (28–42 weeks). In this group the symptoms and signs of complications leading to death started during pregnancy in 15 cases, intrapartum (including 24 hours after delivery) in 12 cases, and postpartum in 18 cases. One mother died before delivery, 12 died within the first 24 hours after delivery and 32 died in the postpartum period.

Underlying cause of death

Hypertensive disease of pregnancy (12/51) was the leading cause of maternal deaths during the study period. The second leading cause was thromboembolism (10/51) (Figure 1). Table I lists the cause of death according to the first diagnosis in the autopsy reports.

Hypertensive disease of pregnancy

In 12 cases the underlying cause was hypertensive disease of pregnancy, and in 10 the condition was diagnosed and treated. Seven had eclampsia. Eight died due to intracranial hemorrhage, and among these five had eclampsia. Two pre-eclamptic patients died of complications due to intravenous fluid overload. One had HELLP syndrome, and one developed DIC after placental abruption – both died due to multi-organ failure.

Table I. The direct causes of 45 maternal deaths according to the first diagnosis in the autopsy reports.

Causes of maternal death	
Thromboembolism	12
Cerebrovascular accidents	9
Intracranial hemorrhage	5
Intracranial infarction	2
Cerebellar herniation	2
Amiotic fluid embolism syndrome	5
Sepsis	4
Anaphylactic shock	2
Complications related to anesthesia	1
Hemorrhage	1
Others	11
Bilateral pneumothorax	1
Placental abruption	1
Cor pulmonale	1
DIC	1
HELLP	1
Aspiration	1
Hepatic encephalopathy	1
Pulmonary edema	1
Pneumonia	1
Subtotal necrosis of the liver	1
Ectopic pregnancy	1

Thrombosis and thromboembolism

Of nine deaths caused by thromboembolism, seven had pulmonary embolism and two had cerebral thromboses. Eight of these women were delivered by cesarean section performed for a fetal indication. The women did not receive thromboprophylaxis recommended today (16).

Amniotic fluid embolism syndrome

There were six deaths due to amniotic fluid embolism syndrome. They all had classic symptoms, such as

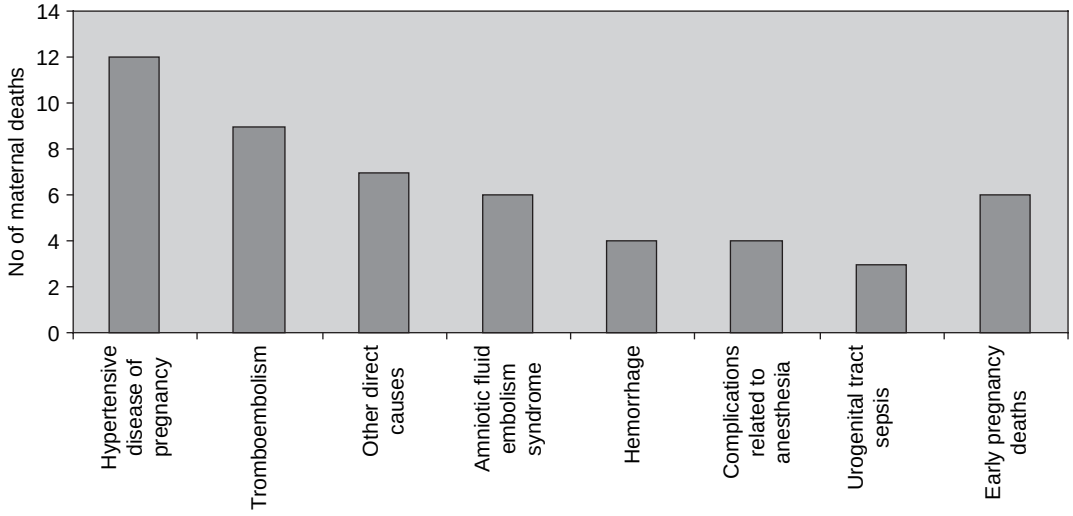

Figure 1. Classification of underlying cause of the 51 direct maternal deaths.

sudden dyspnea and hypotension followed within minutes by cardio-respiratory arrest and some times by DIC. Two patients survived the first cardio-respiratory arrest and primary resuscitation, but an intractable uterine bleeding with multiple transfusions followed. The interval between cardio-respiratory arrest and death varied from 1 hour to 5 days. The diagnosis amniotic fluid embolism syndrome was confirmed by autopsy in five cases that died within 24 hours.

Hemorrhage

Four women died due to postpartum hemorrhage, as a result of hypovolemic shock. Among these, two had profuse bleeding due to uterine atony after spontaneous vaginal deliveries, and two had operative vaginal deliveries with cervicovaginal tears.

Complications related to anesthesia

There were four anesthesia-related deaths, three with general anesthesia and one with epidural analgesia. They all had an emergency cesarean section for cephalopelvic dystocia.

Sepsis

In three patients the underlying cause of death was urogenital sepsis. Two died after vaginal delivery. The third patient presented at 30 weeks with fever and symptoms of a severe upper urinary tract infection, and was delivered by an emergency cesarean section for this reason. During the operation she developed DIC, followed by multi-organ failure.

Other direct causes

Of these seven deaths, four had emergency cesarean and died from complications directly attributable to the operation. One woman had an intracranial hemorrhage, one had a placental abruption and the last one had a respiratory arrest near term because of aspiration of gastric content.

Early pregnancy deaths

Among the six early pregnancy deaths, four had ectopic pregnancies, one a miscarriage and one a hydatidiform mole. Of the women with ectopic pregnancies, two developed anaphylactic shock after the anesthesia was induced. The last two died from bleeding after ruptured tubal pregnancies. The woman with a hydatidiform mole developed sepsis caused by *Clostridium perfringens*. The last woman had a miscarriage at 14 weeks of gestation complicated with massive bleeding followed by a hysterectomy and pulmonary embolism.

Perinatal mortality and morbidity

In 44 cases, the case records included information about the child. Eighteen infants were preterm. Six stillbirths were reported. Two mothers with stillbirth had placental abruption, one had a genital tract sepsis, one had HELLP syndrome, one had both eclampsia and placental abruption outside hospital, and one mother was dead on arrival to the hospital because of the aspiration of gastric content.

Standard of care

Based on documentation in the pre-hospital and hospital case records it was possible to evaluate the standard of care in 49 cases (Table II). Twenty-one cases had substandard care; 17 in the hospital, two at the primary health care level, and one at the self-care level (patient negligence). In one case substandard care was provided both in the hospital and in primary health care (Table III).

Avoidability

In 14 cases (14/49) the death was assessed to be avoidable and in 13 cases (13/49) potentially avoidable according to the guidelines and procedures of today (Table III).

Mode of delivery

Forty-five women gave birth; seven spontaneously, six by vacuum extraction or forceps and 32 by cesarean section.

The cesarean section group

There were three elective and 29 emergency cesarean sections. In 17 cases, there was a maternal indication for the operation and in 15 cases a fetal indication. Twenty-four had general anesthesia (24/32). The maternal deaths were judged to be directly attributable to the operation in 15 emergency and two elective cesarean sections (17/32). Seven women died of pulmonary embolism, four due to postoperative infection, four due to complications related to anesthesia, one due to heart failure, and one had a sudden cardiac arrest. In the study period, a total of 117,521 cesarean sections were performed in Norway among 1,107,373 births. Thus, the estimated fatality

Table II. The relation between underlying cause of death in 49 cases and substandard care, avoidability and cesarean delivery.

Underlying cause of death	Total ($n=49$)	Substandard care ($n=21$)	Avoidable and potentially avoidable cases ($n=27$)	Cesarean section ($n=32$)	Deaths due to cesarean section ($n=17$)
Hypertensive disease of pregnancy	11	6	5	11	3
Thromboembolism	9	5	7	7	6
Other direct deaths	7	1	1	6	3
Amiotic fluid embolism syndrome	6	0	0	3	
Complications related to anesthesia	4	3	4	4	4
Hemorrhage	3	3	3		
Urogenital tract sepsis	3	2	2	1	1
Early pregnancy death	6	1	5		

rate was 0.27/1000 for cesarean deliveries, and 0.01/1000 for vaginal deliveries.

Discussion

In this study we present direct maternal deaths in Norway in the period 1976–1995. The exact number of maternal deaths is hard to determine. The death may occur at different places and departments that do not report routinely to the Medical Birth Registry, and to obtain valid information on all direct maternal deaths we need data from multiple sources, including patient registers, civil registers and cause of death registers. Even in countries where all deaths "need a medical certificate", maternal deaths are frequently missed or misclassified (5,6,19). As a consequence of the imprecise figures reported, the method applied by WHO in order to estimate the rate of maternal mortality in Norway imply that the reported value is multiplied by 1.5 (6). The indirect maternal deaths were impossible to identify in the study period in Norway. In this study we have identified the direct maternal deaths by the MBRN and the Cause of Death Registry. Deaths due to psychiatric illness such as suicide, and late complications possibly related to pregnancy but with the patients hospitalized in other departments than the obstetrical ward, will often be diagnosed without any linkage to pregnancy, and thus they are not classified as indirect maternal deaths. The Confidential Enquiries into Maternal Deaths in the UK 2000–2002 reported that the indirect deaths exceeded the number of direct deaths (9). The most common cause of indirect deaths in the UK was psychiatric illness. To estimate the exact number of maternal deaths in Norway it is necessary to link the Medical Birth Registry, the National Patient Registry and the Cause of Death Registry as done in Finland (20,21). We hope that the Norwegian health authorities provide such data, including indirect and late maternal deaths.

The MMR of direct maternal deaths in the period 1976–1995 was 5.5 per 100,000, which is lower than estimated in the Nordic countries for 1970–1979 of 7.2 per 100,000 births (22). In the 20-year study period, the leading underlying causes of death, which started the cascade leading to the women's deaths, were hypertensive disease of pregnancy and thromboembolism. An important factor associated with the maternal deaths was mode of delivery (23,24). The risk of abdominal delivery is difficult to assess due to confounding factors. In many cases, however, the mother was healthy at the start of operation. We found that among the 45 women who gave birth, 32 were delivered by a cesarean, and in 17 of these, the death of the mother was directly ascribed to the operation.

The maternal deaths were classified according to the standard of care and avoidability. The standard of care was judged according to the standards at the time of the death, and the avoidability was evaluated

Table III. Assessment of the standard of care and avoidability in 49 cases of maternal deaths.

	Avoidable ($n=14$)	Potentially avoidable ($n=13$)	Unavoidable ($n=22$)
Acceptable care ($n=28$)	2	8	18
Substandard care ($n=21$)	12	5	4
Level of substandard care			
• Hospital	11	4	2
• Antenatal care	1	1	
• Hospital and antenatal care			1
• Patient			1

according to the guidelines and treatment of today. The avoidability could also have been evaluated according to the possibilities of treatment at the time of death, but we found it more interesting to look at it from the perspectives of the treatment options of today. The discrepancy between these two aspects of time is shown in Table III. Although the treatment given is judged to be acceptable, the deaths can be avoidable or potentially avoidable following the guidelines of today. During the study period important improvement in the standard of care has taken place in anesthesiology and regarding thromboprophylaxis. Substandard care was delivered in 21 (21/49) of the cases, and mainly in the hospitals (18/21). The substandard care in hospitals was mainly due to inadequate surveillance and treatment of the hypertensive disease, inadequate thromboprophylaxis, and complications due to clearly inappropriate actions taken by the staff.

Perspectives

We need a Nordic Confidential Inquiry with recent, not historical data, every two or three years in order to survey this rare and very serious outcome, and to elucidate the impact of increasing age and obesity of the parturients and the increasing cesarean section rate. This will offer an alternative to the medicolegal processes often pursuing these cases. An open audit performed by health care professionals is preferable to the medicolegal scrutiny of these events that creates fear and defensive medicine instead of quality improvement for the benefit of the women.

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