Maternal mortality in the Cape Province, 1990 - 1992

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Objective. This study is the first report on maternal deaths for an entire health service within a province in South Africa.

Design. A descriptive study with analytic components. Characteristics of patients who died from the most common causes and in different regions within the province were compared.

Setting. All 111 Cape provincial hospitals and hospitals supported by the Cape Provincial Administration.

Subjects. Maternal deaths notified from January 1990 to December 1992.

Outcome measures. The maternal mortality rate (MMR), characteristics of the patients who died and causes of death. Avoidable factors that may have contributed to the fatal outcome.

Results. There were 362 186 deliveries of liveborn babies and 138 maternal deaths were notified, giving a MMR of 38.1/100 000 liveborn babies. Of these deaths 110 (79.7%) were direct and 28 (20.3%) indirect obstetric deaths. The three most common direct causes of maternal death were hypertensive disorders in 39 patients (28.3%), haemorrhage in 30 (21.8%) and sepsis in 22 (15.9%). The most common indirect cause of death was heart disease 10 (7.2%). The MMR for the different regions did not differ significantly. Avoidable factors, including patient-related factors, were present in 23.2% of cases.

Conclusions. The study may serve as a model for health authorities on how to collect data on maternal deaths throughout a whole region. This surveillance may be implemented without any additional cost to a health authority. Management of medically related avoidable factors, i.e. laparotomy for intra-abdominal sepsis and vaginal delivery after intra-uterine death due to abruptio placentae or severe pre-eclampsia, involves decision-making in larger regional and tertiary hospitals.

Following the publication of perinatal data from 18 rural hospitals[1] in the Cape Province, the Continuing Perinatal Education (COPE) Committee of the Hospital and Health Services Branch of the Provincial Administration of the Cape of Good Hope recommended the collection of data on all births and perinatal deaths since July 1987 in all 111 Cape

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provincial hospitals and hospitals supported by the Cape Provincial Administration (Fig. 1). Deliveries at midwife obstetric units are reported together with the data from their base hospitals. Notification of maternal deaths became part of this surveillance system from January 1990. This study is the first report on maternal deaths for an entire health service within a province in South Africa. Previously reported studies were either done at a single hospital,[2-4] in a city[5,6] or at hospitals from various regions participating on a voluntary basis.[7,8]
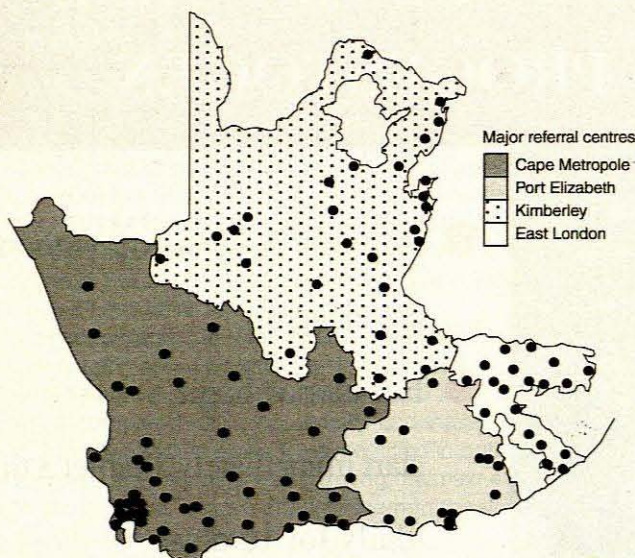

Fig 1. Cape provincial hospitals and hospitals supported by the Cape Provincial Administration (N = 111). The four regions correspond to referral patterns within the province.

Fig. 2. The maternal mortality notification form used by the Cape Provincial Administration.

Materials and methods

During the last quarter of 1989, a directive and notification forms (Fig. 2) were sent by the Deputy Director-General of the Hospital and Health Services Branch to all 111 Cape provincial hospitals and hospitals supported by the Cape Provincial Administration. The notification form was similar to that used by the late Professor E. Boes for the first large hospital-based maternal mortality survey in southern Africa.[6,7] The patient's name as well as the name of the person notifying the case were omitted to preserve confidentiality. However, the rank of the person notifying must be recorded. The collection of data on all births and perinatal deaths was already well established by this time.[9,10] Incomplete forms were identified by the co-ordinator of obstetric and neonatal services of the branch, and the hospital concerned was then requested to provide the missing information. Prior to the final analysis of the data, all hospitals with incomplete forms were asked by the author to provide outstanding information.

The World Health Organisation's definitions of maternal deaths, direct obstetric deaths and indirect obstetric deaths were used.[11] However, the 42-day postpartum period was not adhered to as some patients survived their obstetric complications and died in intensive care units after this period. The maternal mortality rate (MMR), in accordance with the WHO, was calculated as the number of maternal deaths per 100 000 live births. Avoidable factors were considered to be present when there was some departure or omission from the accepted standard of care that may have contributed to the fatal outcome. However, it does not mean that the death could have been prevented or that the factor itself was the direct cause of the patient's death. Avoidable factors were divided into patient- and medical care-related factors. The latter group was further subdivided into patients who received inadequate treatment, inappropriate treatment and in whom a delay in diagnosis occurred.

The province was divided into four regions corresponding to referral patterns (Fig. 1), viz. the Western Cape referring to the Cape Metropole, the Eastern Cape referring to Port Elizabeth (PE), the Eastern Cape referring to East London (EL) and the Northern Cape referring to Kimberley. The MMR, characteristics of patients who died and causes of death for the different regions were determined and compared.

Categorical data were compared by the chi-square test. Mean values were compared by Student's t-test and median values by the Wilcoxon rank sum test, where comparisons were appropriate between two groups. When median values of three or more groups were compared, Kruskal-Wallis analysis of variance (ANOVA) was used. For mean values one-way ANOVA was used.

Results

All 111 provincial and province-supported hospitals were included in the surveillance. Of the hospitals which initially submitted incomplete forms, a satisfactory response was subsequently elicited from all but one. From January 1990 to December 1992, 369 130 deliveries (362 186 liveborn babies) and 138 maternal deaths were reported by 24 hospitals (Table I).

Table I. Deliveries, maternal deaths and maternal mortality rates in the Cape Province, January 1990 - December 1992

	1990	1991	1992	Total
Maternal deaths	42	53	43	138
No. of deliveries	123 543	125 125	120 462	369 130
MMR (all deliveries)	34.0	42.4	35.7	37.4
No. of liveborn babies	121 301	122 689	118 196	362 186
MMR (WHO)	34.6*	43.2*	36.38*	38.1

* Chi-square $P = 0.52$.

The five tertiary hospitals (Groote Schuur, Tygerberg, Livingstone, Frere and Kimberley Hospital) reported 92 (66.7%) deaths. The MMR for the different years did not differ significantly. Of these deaths, 110 (79.7%) were direct and 28 (20.3%) indirect obstetric deaths. An additional 3 non-obstetric deaths were excluded from the analysis. These latter deaths were caused by acute myeloblastic leukaemia, a massive haemorrhage from the aorta following a stab wound in the back and a massive intra-abdominal haemorrhage from a poorly differentiated mesenchymal tumour of the duodenum, respectively.

The age, gravidity, parity, gestational age and birth weight distribution are given in Table II. The age distribution is normal and unimodal around the average and median ages. Death before delivery occurred in 22 (15.9%) patients and death before 20 weeks' gestation in 3 (2.2%). These 3 patients died as a result of haemorrhage from a ruptured uterus at 18 weeks' gestation, a choriocarcinoma following an abortion and pulmonary tuberculosis at 14 weeks' gestation, respectively. Of the 113 babies delivered, 84 (74.3%) were liveborn of whom 3 (2.7%) died neonatally. Twenty-seven (23.9%) babies were stillborn and the outcome in 2 cases was undetermined.

Table II. The maternal age, gravidity, parity, gestational age and birth weight distribution of the patients and babies delivered

	Average (SD)	Median	Mode	N
Age (yrs)	27.8 (7.0)	28	30	138
Gravidity	2.9 (1.9)	2	1	138
Parity	2.6 (1.8)	2	1	138
Gestational age (wks)*	34.8 (5.1)	36	40	129
Birth weight (g)*	2 454 (959)	2 500	3 000	77

* Excluding 2 patients with a gestational age < 20 weeks.

Of the 138 maternal deaths, 92 (66.7%) received antenatal care (Table III). Although the proportion of patients receiving antenatal care increased from 1990 to 1992, this difference was not significant. The population groups were: black 68 (49.3%), coloured 67 (48.6%), white 1 (0.7%) and not reported in 2 cases. Autopsies were done on 51 (37.0%) patients and in 8 (5.8%) cases it was uncertain whether an autopsy was done or not.

Table III. The number of patients who received antenatal care

	1990	1991	1992	Total
Yes (%)	25 (59.5)	36 (67.9)	31 (72.1)	92 (66.7)
No	10	12	7	29
Unknown	7	5	5	17
Total	42	53	43	138

* Chi-square $P = 0.46$.

The causes of maternal deaths are summarised in Table IV. The specific causes within each of these groups were as follows.

Table IV. The causes of maternal deaths

	No.	%
Direct obstetric causes		
Hypertensive disorders of pregnancy	39	28.3
Haemorrhage	30	21.8
Sepsis	22	15.9
Pulmonary embolism	8	5.8
Other causes	10	7.2
Indirect obstetric causes		
Heart disease	10	7.2
Tuberculosis	4	2.9
Other	15	10.9
Total	138	

Hypertensive disorders of pregnancy. Intracranial haemorrhage was the most common specific cause of death in 16 (41.0%) of the 39 patients in this group, followed by adult respiratory distress syndrome in 5 (12.8%) and cardiac causes in 5. In the last subgroup arrhythmia was the possible cause of death in 2 cases, myocardial infarction in 2 cases and cardiac tamponade in 1 case. Eclampsia caused 4 deaths and pulmonary oedema and renal failure 3 deaths each. One of the patients in the renal failure subgroup also had adult respiratory distress syndrome and 1 multiple organ failure. HELLP syndrome, hepatic haemorrhage and a pheochromocytoma caused 1 death each. Eclamptic convulsions were present in 17 (43.6%) of the 39 patients in the hypertensive group. In 4 (23.5%) of the patients with eclampsia, the convulsions were thought to be the cause of death.

Haemorrhage. Abruptio placentae was the most common specific cause of death. It occurred in 12 (40%) of the 30 patients in this group. This was followed by postpartum haemorrhage in 7 cases (23.3%), ruptured uterus in 6 (13.3%), haemorrhage following caesarean section in 4 (13.3%) and puerperal haemorrhage in 1.

Sepsis. Post-caesarean section sepsis was the most common specific cause of death, and occurred in 12 (54.5%) of the 22 patients in this group. Necrotising fasciitis and pneumonia caused 1 death each. A single patient died following a hysterotomy and another where the primary focus of infection was in the urinary tract. Puerperal sepsis caused 6 (27.3%) deaths. Sepsis following postpartum tubal ligation and an infected perineal haematoma progressing to septicaemia caused death in 1 patient each.

Cardiac disease. Heart valve lesions were the most common specific cause of death, and occurred in 6 of the 10 patients in this group. Cardiomyopathy (3 cases) and viral myocarditis (1 case) were the next most common.

Other direct obstetric causes. Amniotic fluid embolism was the most common specific cause of death (5 patients in this group). Of these, 1 had triplets and 1 twins. Anaesthetic complications followed next, accounting for 3 deaths. These deaths were caused by an airway obstruction due to a nasopharyngeal tumour, an aspiration pneumonia following a difficult intubation and an unknown cause, respectively. One patient each died of acute yellow atrophy of the liver and a choriocarcinoma.

Other indirect obstetric causes. Tuberculosis was the most common specific cause of death, and occurred in 4 patients in this group. Two patients each died of the following causes: ruptured aneurysms (1 renal and 1 aortic aneurysm), AIDS, trauma (both following suicide) and unknown causes. Cholecystitis, acute pancreatitis, varicella pneumonia, end-stage glomerulonephritis, a cerebrovascular accident, morbid obesity and a strangulated diaphragmatic hernia all caused 1 death each.

Avoidable factors. No avoidable factors were present in 82 (59.4%) patients. Patient-related avoidable factors were present in 24 (17.4%) cases. Of these patients, 22 did not present for antenatal care, 1 did not respond to dangerous symptoms and another refused admission and treatment.

Avoidable factors related to medical care were present in 32 (23.2%) patients. Of these, 15 patients received inadequate treatment. Within this subgroup, puerperal sepsis where a laparotomy was indicated but not performed, was the most common problem (6 patients). Ten patients received inappropriate treatment; caesarean section performed on patients with an intra-uterine death (IUD) was the most common problem (4 cases). Of these, 3 patients had abruptio placentae and 1 an IUD due to severe pre-eclampsia. In 7 patients a delay in the diagnosis of the problem that caused the death may have contributed to the death.

Statistical analyses to determine the relationship between the three most important causes of death (hypertensive disorders, haemorrhage and sepsis) and population group, antenatal care and age did not reveal any statistically significant differences. However, the median parity (3.2) of the group that died of haemorrhage differed significantly ($P = 0.03$ and $P = 0.049$) when compared with the groups with hypertensive disorders (2.5) and sepsis (2.1) respectively. The gestational age (33.2 weeks) of the group with hypertensive disorders differed significantly ($P = 0.001$ and $P = 0.003$) when compared with the groups with haemorrhage (36.7 weeks) and sepsis (36.7 weeks) respectively. The mean birth weight (2 174 g) of the hypertensive group differed significantly ($P = 0.01$) from that of the group with haemorrhage (2 852 g). The mean birth weight (2 598 g) of the group with sepsis did not differ significantly from that in the other groups.

MMR in different regions. The MMR for the different regions did not differ significantly (Table V). There were no significant differences with regard to gravidity, parity, birth weight and the proportion of direct and indirect causes of death. There was a trend towards younger patients in the Eastern Cape (EL) and a lower gestational age in the Western Cape (Table VI). There were significantly more black patients in the Eastern Cape (EL) and more patients who received antenatal care in the Western Cape and Eastern Cape (PE) (Table VI). Significantly fewer autopsies were undertaken in the Northern Cape (Table VI). Analysis of cause of death by region showed that hypertensive

disorders were the most common cause of death in the Western Cape and Northern Cape, whereas haemorrhage caused most deaths in the Eastern Cape (PE) and sepsis in the Eastern Cape (EL), although these differences were not statistically significant (Table VII). There were no statistically significant differences with regard to avoidable factors between the different regions (Table VIII).

Table V. The maternal mortality rate for the different regions

Region	Total deliveries	Maternal deaths	MMR
Western Cape	208 201	72	34.6
Eastern Cape (PE)	77 034	31	40.2
Northern Cape	41 587	17	40.9
Eastern Cape (EL)	40 666	18	44.3

$P = 0.74$.

Table VI. The maternal age, gestational age, population group, booking status and number of autopsies done in the different regions

	Western Cape	Eastern Cape (PE)	Northern Cape	Eastern Cape (EL)	P-value
Average age (yrs)	28.2	29.2	27.4	24.1	0.08
Gestational age (wks)	33.7	35.5	36.2	36.7	0.08
Population group					
Coloured	43	13	10	1	0.002
Black	26	18	7	17	
Booking status					
Yes	58	22	5	7	0.0002
No	8	6	6	9	
Autopsies done					
Yes	32	10	2	7	0.03
No	33	21	15	10	

Table VII. Analysis of the cause of death by region

	Western Cape		Eastern Cape (PE)		Northern Cape		Eastern Cape (EL)		
	No.	%	No.	%	No.	%	No.	%	P-value
Hypertensive disorders	20	27.8	9	29.1	6	35.3	4	22.2	0.86
Haemorrhage	15	20.8	11	35.5	2	11.8	3	16.7	0.20
Sepsis	11	15.3	5	16.1	3	17.6	5	27.8	0.66
Heart disease	5	6.9	1	3.2	2	11.8	2	11.1	
Embolism	4	5.6	1	3.2	1	5.9	2	11.1	
Other	17	23.6	4	12.9	3	17.6	2	11.1	
Total	72	100	31	99.9	17	100	18	100	

Table VIII. Analysis of avoidable factors by region

Avoidable factors	Western Cape		Eastern Cape (PE)		Northern Cape		Eastern Cape (EL)	
	No.	%	No.	%	No.	%	No.	%
None	50	69.5	15	48.4	9	52.9	8	44.4
Patient-related*	8	11.1	6	19.3	5	29.4	5	27.8
Medical care-related	14	19.4	10	32.3	3	17.6	5	27.8
Total	72		31		17		18	100

* $P = 0.18$.

Discussion

The global estimate of the MMR for developing countries is 450 and for developed countries 30/100 000 live births.[11] The risks of pregnancy are highest in sub-Saharan Africa

with an estimated MMR of 570 for southern Africa.[11] This rate stands in stark contrast to the MMR of 8.5 reported between 1976 and 1987 in the UK.[12]

The MMR of 38.1/100 000 live births is lower than other published rates for South Africa, which vary from 64.4 to 450.[2-8] The lower rate may be partially explained by the exclusion of referral bias as all hospitals (excluding private hospitals) within an entire region were included. However, the absence of data on deliveries and maternal deaths at home is a confounding variable. Enquiries into the extent of home deliveries and possible maternal deaths outside the health care system in remote areas of the Northern Cape and Eastern Cape (Prieska, Kuruman, Grahamstown, Cradock and Somerset East) indicated that patients not included in the study may be limited. The effect on the MMR of deliveries outside the public health care system must be investigated.

The causes of death correspond with the findings of Van Coeverden de Groot[5,6] and Boes,[7,8] both with regard to groups of causes and their order. This is not surprising, as the former study examines the data from a large tertiary hospital in the former Cape Province, and 102 (38.2%) of the 267 hospitals included in the Boes study are hospitals within the former Cape Province. Sepsis was the most common cause of death in studies at both Edendale and Pelonomi Hospitals,[2,4] and this corresponds with the findings in the Eastern Cape (EL), perhaps because of similarities in patient profile, socio-economic and health care structures. The studies from both King Edward VIII and Edendale Hospitals[2,3] showed that the second most common cause of death was abortion, whereas in this study only 3 deaths prior to 20 weeks' gestation were reported. This may be because of underreporting of deaths in early gestation; however, on discussing these findings with senior staff members of the three largest obstetric and gynaecology departments (Peninsula Maternity and Neonatal Services, Tygerberg Hospital and Livingstone Hospital) in the former Cape Province, it was confirmed that death due to complications of early pregnancy has indeed become extremely rare.

Avoidable factors, including patient-related factors, were present in 23.2% of cases. This corresponds to the findings of Barford and Parkes[2] and Van Coeverden de Groot,[6] who found avoidable factors to be present in 22% and 30% of cases respectively, although the former only included avoidable factors during inpatient management. Boes[7] and Cooreman et al.[4] found a much higher percentage (80.2 - 80.9%) of cases with avoidable factors, although in 309 of the 812 deaths in Boes's study, insufficient information precluded assessment of avoidable factors.

Prevention of medically related avoidable factors, i.e. early laparotomy for intra-abdominal sepsis and vaginal delivery of an IUD following abruptio placentae and in the presence of pre-eclampsia, involves decision-making at larger regional and tertiary hospitals. Under- and postgraduate training should take cognisance of these facts and provide ongoing educational programmes aimed at the medical staff caring for these patients. It is, however, distressing that as far back as 1977, Barford and Parkes[2] had already pointed out that 'there is an understandable reluctance on the part of obstetricians to re-operate on a woman' and urged 'a more aggressive approach to be justifiable'. Boes will always be remembered for her saying 'too little and too late'.[13]

The lack of a significant difference on comparison of MMRs between the four regions was surprising, given that both the academic hospitals are within the Western Cape region. However the two most common causes of death in the Western Cape are hypertensive disorders (41% with intracranial haemorrhage) and haemorrhage (40% with abruptio placentae). Pre-eclampsia is a significant risk factor for abruptio placentae.[14] Patients at risk for pre-eclampsia may develop these complications suddenly, and these conditions may be difficult to prevent, even with regular antenatal care.[15]

The Cape Province experience may serve as a model for other health authorities on how to collect data on maternal deaths throughout a whole region. A prerequisite is the collection of perinatal data, i.e. the total number of deliveries, number of stillborn babies and early neonatal deaths for each hospital, as this solves the problem of the denominator needed for the calculation of rates. Regular control of maternal death notification forms for errors and missing data is mandatory. The health authority must liaise with specialists in obstetrics and gynaecology for analysis and interpretation of the data. Feedback of information to the regions is necessary. Problem areas are identified and must receive special assistance with regard to ongoing education,[16] hospital visits and assistance. This type of surveillance may be implemented without any additional cost to a health authority.

Notification of all births and deaths in a region is of vital importance, as the number of births serves as a common denominator for important health indicators, i.e. infant mortality rate and MMR. Death certificates must include a question on whether the deceased was pregnant and whether the pregnancy was directly or indirectly responsible for the death. The importance of notification of early pregnancy complications that result in deaths must be stressed.

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