

A 36-year review of maternal deaths in a low-resource country

Abstract

Objective: To review and analyze the maternal deaths over a 36-year period to determine the maternal mortality rate (MMR), determine trends in maternal mortality, and compare maternal care between 1981-1998 and 1999-2016. Methods: This retrospective study of all maternal deaths over a 36-year period commencing in 1981 was performed at the Mt. Hope Maternity Hospital. The extracted for the case notes of these women who died in pregnancy, childbirth, or within 42 days of termination of the pregnancy irrespective of the duration of the pregnancy. All maternal deaths obtained from the hospital's Medical Records Department were cross-checked at the Registrar General Department at the Ministry of Legal Affairs for accuracy and completeness.

Results: The MMR for the period 1981-1998 was found to be 35.16 per 100,000 and the MMR for the period 1999-2016 was found to be 22.76. The highest rate of maternal deaths was found in patients >40 years of age, with an MMR 89.2 per 100,000 in the period 1981-1998, and 133.5 per 100,000 in the period 1999-2016, in Afro-Caribbean patients, with an MMR of 47.2 per 100,000, and in patients with no formal education, with an MMR of 223.9 per 100,000. There was a shift in maternal causes of death, with hypertensive disorders of pregnancy accounting for 24 deaths in the period 1981-1998, and 4 deaths from 1999-2016, anesthetic complications accounting for 5 deaths in 1981-1998, and 0 deaths thereafter, and venous thromboembolisms accounting for 1 death in the period 1981-1998, and 5 deaths in the period 1999-2016. Overall, maternal care improved markedly in 1999-2016, with a drop in the MMR by a value of 53% from 1990, which is higher than the world average of 44%.

Conclusion: Trinidad must continue to improve its overall maternal care to improve the MMR to allow a decrease by more than 75%, in keeping with the Millennium Developmental Goals. With an increase in funding, advent of guideline and evidence-based medicine and overall improved maternal care, Trinidad has seen a continuing reduction in the maternal mortality rate.

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Introduction

Pregnancy remains an important contributor of deaths among women of the reproductive age, especially in developing countries where 99% of all maternal deaths occur.¹⁻³ Approximately 303,000 women died in pregnancy and childbirth in 2015, with about 23000 of these deaths recorded in Latin America and the Caribbean.⁴ That many of these deaths are preventable lend testimony to the statement that maternal mortality remains a neglected tragedy.⁵

In order to devise a strategy which may prove impactful on formulation of policy to lower maternal deaths locally and internationally, to develop new guidelines, to provide better quality of obstetric and neonatal care and to learn from the experiences of others, it is imperative to enquire into, and document the circumstances surrounding each death in order to fully elucidate the possible train of events which may have contributed to the maternal loss and furthermore, to investigate the likely causes as well as possible avoidable antecedent risk factors. The Confidential Enquiries into Maternal Deaths in the United Kingdom, which were the first to accomplish this task, have demonstrated its value as a major contributing factor in reducing maternal deaths in the UK.

The aim of this study was to continue to monitor the trends and likely contributing and etiological factors into maternal deaths in a

low resource country in 6-year intervals. Particular attention was paid to a comparison between 1981-1998 and the later 1999-2016, where major changes in the health system were implemented, and this country became a signatory to the United Nations Millennium Development Goals. This study would have explored what strides or further gains were achieved as a result of these new policies and practices in the second half.

The current review was conducted at the Mt. Hope Maternity Hospital, Trinidad and Tobago where active maternal mortality surveillance has been in existence since its inception in 1981. This is a tertiary teaching institution which is affiliated with The University of the West Indies at which training of medical students, specialist Obstetricians and Gynecologists, nurses, midwives and pharmacists occur. Referrals are received from district health facilities, primary and secondary hospitals, general practitioners and obstetricians. Due to this hospital's strategic geographic location serving one third of the country's population, the problems and outcomes highlighted in this critique give a fair representation of the fatal obstetric complications encountered in the entire country.⁶ This analysis of all maternal deaths included demographic characteristics as well as information of the current pregnancy and their past obstetric and medical history. Medical records, death certificates and where available, postmortem reports of all maternal deaths were evaluated.

Materials and methods

This retrospective study of all maternal deaths over a 36-year period commencing in 1981 was performed at the Mt. Hope Maternity Hospital. Information was extracted for the case notes of these women who died in pregnancy, childbirth, or within 42 days of termination of the pregnancy irrespective of the duration of the pregnancy. All maternal deaths obtained from the hospital's Medical Records Department were cross-checked at the Registrar General Department at the Ministry of Legal Affairs for accuracy and completeness. Where necessary, comparison of the information obtained was performed using the hospital's annual statistical reports.

We documented maternal age, ethnicity, level of education, employment status and body mass index (BMI). Obesity was defined as a BMI ≥ 30 kg/m². The quality of the antenatal care was assessed on the number of prenatal visits. A minimum of four visits was considered appropriate care. The immediate and the underlying cause(s) of each death were recorded in order to determine the chain of events which may have led to the obstetric loss. Approval for the study was obtained from the Ethics Committee of the hospital and from the North Central Regional Health Authority, which has jurisdiction over the institution. Postmortem was not done on all cases mainly due to socio-cultural and religious reasons. Statistical analysis was conducted using the IBM Statistical Program for Social Sciences (SPSS 25.0) software, with comparisons between continuous variables being made using the Student's *t* test. Statistical significance was set at $p < 0.05$.

A maternal death was defined as a death of any woman in pregnancy, childbirth, or within 42 days of termination of the pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. A direct death resulted from obstetric complications, from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above. An indirect death was one which resulted from previous existed disease or diseases that developed during pregnancy and which was not due to direct obstetric causes but was aggravated by the physiologic effects of pregnancy.

Maternal mortality rate (MMR) was defined as the number of maternal deaths in a given time for 100,000 maternities. In this analysis, maternal mortality rate was preferred over maternal mortality ratio since the hospital's data concerning the total number of maternities were deemed more accurate than those of live births.

Results

In this 36-year study, 53 maternal deaths occurred among 179,600 mothers resulting in a MMR of 29.6 per 100,000 maternities. During the first half of the analysis from 1981 to 1998, 35 deaths were recorded among 100,030 mothers. For the second half of analysis from 1999 to 2016, there were 18 deaths out of 79,570 maternities. A decrease of 20,040 women gave birth in the second half of the investigation, and this is in keeping with the declining fecundity rate in the country. The mean MMR for the first and second halves of the study were 35.2 and 22.7 per 100,000 maternities respectively (Table 1). This represents a 37% decrease in the MMR in the latter half ($p < 0.05$). Notably, the MMR increased for the 6-year intervals 1981-1986 and

1987-1992, after which the values leveled off in the following 6-year interval, but none of these changes were statistically significant ($p > 0.05$). Thereafter, there was a progressive decline in the rates with the lowest MMR of 19.9 per 100,000 maternities during the period 2011-2016.

Table 1 Maternal Mortality Rates per 6-year interval

Intervals	No. of Mothers	No. of Maternal Deaths	MMR/100000
1st Half			
1981-1986	34560	11	31.8
1987-1992	34510	13	37.6
1993-1998	30460	11	36.1
Total (1981-1998)	99530	35	35.16
2nd Half			
1999-2004	28990	7	24.1
2005-2010	25018	6	23.9
2011-2016	25062	5	19.9
Total (1999-2016)	79070	18	22.76

Among women in the advanced maternal age group (>35 years), the overall MMR was 76.5 per 100,000 maternities, which was 4.6 times higher than that for women between 20-24 years of age. The MMR for all ages except among women >40 years, was found to be significantly lower in the second half when compared to the first half of the analysis ($p < 0.05$).

During the study period, for all deliveries, teenage pregnancies and pregnancies in women of advanced maternal age (>35 years) accounted for 12% and 18% of all pregnancies respectively. The remaining 70% of mothers were between 20 and 34 years of age.

The MMR for women aged 40 years or older was 89.2 per 100,000 between 1981-1998, representing a 4-fold higher rate among those in the age group of 20-24. A similar trend existed in the second half of the analysis, with women in the age group 40 and over years having a 12-fold higher rate than their younger counterparts between 20-24 (Table 2).

Table 2 Maternal Mortality Rates for 1981-1998 and 1999-2016

Interval	1981-1998			1999-2016		
	Age (y)	Mothers	Deaths	MMR	Mothers	Deaths
<20	19267	8	41.5	12881	4	31.1
20-24	19808	4	20.2	16811	2	11.89
25-29	27290	6	21.98	23105	3	12.98
30-34	20613	6	29.1	15296	2	13.1
35-39	9190	8	87.1	7981	3	37.6
≥ 40	3362	3	89.2	2996	4	133.5

When examined by ethnicity, 32 deaths (61.2%) were observed among Afro-Caribbean women, and 16 deaths (30.2%) in women of East Indian ethnicity, despite the number of women of each ethnic group who delivered being similar. The remainder of maternal losses was seen in mixed races. The MMR was two times higher among Afro-Caribbean women compared to those of an East Indian background (Table 3). An inverse relationship was evident between maternal deaths and level of education. Among women with no formal

education or only up to primary level, there were 36 deaths recorded which was twice as high as that among women with either secondary or tertiary education ($p < 0.05$).

Table 3 Demographics

Characteristics	No. of Mothers	No. of maternal deaths	MMR/100,000
Age			
< 20	32148	12	37.3
20-24	36619	6	16.4
25-29	50395	9	17.9
30-34	35909	8	22.3
35-39	17171	11	64.1
≥40	6358	7	110.1
Ethnicity			
Afro-Caribbean	67868	32	47.2
East Indian	62510	16	25.6
Others	48222	5	10.4
Level of Education			
No Formal Education	3572	8	223.9
Primary	39292	28	71.3
Secondary	103588	15	14.5
Tertiary	32148	2	6.2

Direct obstetric causes accounted for 50 deaths, with the main underlying etiologies including hypertensive disorders of pregnancy ($n=28$), obstetric hemorrhage ($n=9$), and anesthesia-related causes ($n=5$) (Table 4). Three women succumbed from indirect causes, one each from sub acute bacterial endocarditis associated with rheumatic heart disease, aplastic crisis in a patient with sickle cell anaemia, and thirdly from acute myeloid leukemia.

Between 1981 to 1998, hypertensive disorders of pregnancy (pre-eclampsia and eclampsia) accounted for 24 deaths (45.3%). The pathological events leading to these deaths included cerebrovascular accident ($n=10$), cardiorespiratory failure ($n=8$), postpartum hemorrhage and disseminated intravascular coagulation ($n=3$), amniotic fluid embolism ($n=2$), and acute fatty liver in pregnancy ($n=1$). Two out of every 3 maternal deaths from hypertensive disorders in pregnancy occurred in obese, Afro-Caribbean women. Seven of these maternal losses were in the advanced maternal age category. In the second half of the analysis, 4 women died from hypertensive disorders of pregnancy. This represents a decline of 83.3% from the first half of the analysis from 1981-1998.

Whereas 5 women died from anesthesia-related causes between 1981-1998, no such deaths were observed for the second half of the analysis. Three of these deaths were as a result of cerebral hypoxia from faulty intubation by junior, unsupervised anesthetists at the time of Cesarean section, and the remaining two were from aspiration pneumonitis (Mendelson's Syndrome).

For the first half of the analysis, 12 deaths occurred among 8678 Cesarean sections, and in the latter half, 6 deaths were observed among 11,700 Cesarean births, corresponding to MMRs of 138.2 and

51.3 per 100,000 Cesarean sections respectively. This represents an approximately 60% decrease in Cesarean-section related deaths.

Among the 9 patients who succumbed from major obstetric hemorrhage, the underlying causes were uterine atony, uterine rupture, ruptured ectopic pregnancy, liver rupture, amniotic fluid embolism, placenta accreta and anaphylactic shock from a mismatched blood transfusion. Six deaths were recorded from massive venous thromboembolism. Four of these losses were seen in the last 6-year period with the predisposing factors being maternal age >40 years ($n=2$), obesity ($n=3$) and Cesarean sections ($n=4$) (Figure 1).

Table 4 Main Causes of Maternal Deaths

Causes	1981-1998	1999-2016	Total
Hypertensive Disorders	24	4	28
Postpartum Hemorrhage	6	3	9
Venous Thromboembolism	1	5	6
Amniotic Fluid Embolism	2	4	6
Others	2	2	4
Total	35	18	53
Anaesthesia-Related Deaths	5	0	5
Cesarean Section Associated Deaths	12	8	20

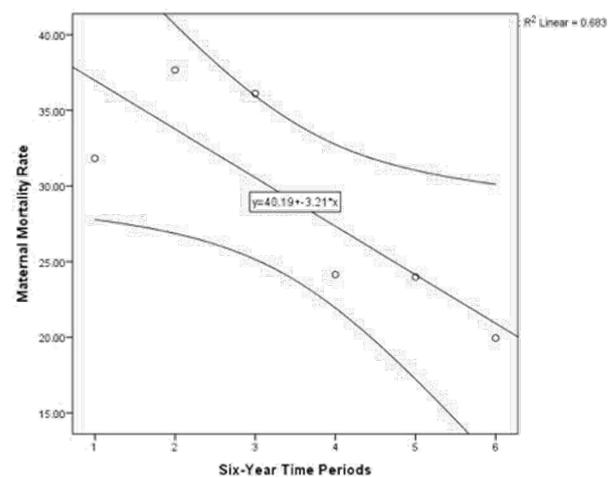


Figure 1 Linear Regression Curve of Maternal Mortality Rate through Six-Year Time Periods.

Discussion

In the present 36-year study, the mean MMR was 29.6 per 100,000 maternities, which is 3.4 times higher than that recorded in the last triennium in the United Kingdom.⁷ On the contrary, the figures for developing countries are at least 7 times greater than ours. Whereas we observed a 13% increase in the rates between 1981-1986 and 1993-

1998, a progressive decline during the next three 6-year intervals with the lowest rate of 19.9 per 100,000 was experienced for the period of 2011-2016. Our findings are similar to those of the Caribbean islands, Barbados and Cuba, but much lower than the rate of 89 reported for Jamaica. Highest MMR are recorded in Sub-Saharan Africa which carry a point estimate of 546 and a lifetime risk of maternal death of 1 in 36.⁸ In 2015, it was estimated that 99% of all maternal losses occurred in developing countries, especially Sub-Saharan Africa and South-East Asia.¹⁻³

These alarmingly high rates of maternal deaths bear testimony to the serious challenges facing international agencies with a mandate in health such as the World Health Organization, World Bank, and policy-makers, governments, health care workers especially in low and middle resource countries where the safety of childbearing has not been accorded a high priority, and social programs have become a neglected tragedy.^{3,5}

To address the disturbingly high MMR worldwide, the United Nations took the bold step with its Millennium Development Goals⁹ of setting a target for its member states to reduce the 1990 MMR by three-quarters in 2015. Our results of a 53% decline concur with the 50% decline seen in Latin America and the Caribbean. These figures are better than the 44% seen globally. It is estimated that the current global lifetime risk of a maternal death is 1 in 180 as compared to 1 in 73 in 1990.⁸

That in this analysis 18 deaths were encountered in mothers of advanced maternal age, especially among women over 40 years, is consistent with the hypothesis that a decrease in maternal age may have a favorable impact on maternal survival.^{10,11} A similar observation was made in the United States in which one third of maternal deaths were seen in women aged 40 years or older, compared with only 3% of live births.¹² In the UK, the relative risk of a maternal demise among those 40 years and over for the triennia 2010-2012 and 2013-2015 were 3.51 and 3.17, respectively, compared to mothers between 20-24 years.⁷ Our finding that women between 20-24 years had the lowest MMRs concurs with those of researchers in the UK.

The observation that the majority of deaths in our series was among women who had only basic formal education and by extension, belong to the lower socio-economic groups, and Afro-Caribbean ethnicity is in keeping with the findings in the UK, in which deaths among women from Black minority backgrounds were significantly higher than in white women (RR 4.28; 95% CI 2.65 to 6.69). A similar trend existed in the USA where maternal mortality rate for non-Hispanic Black women was almost 3 times higher than that of non-Hispanic white women.

The mean MMR in the second half of this study was 63% lower than in the first half. This improved outcome can be attributed to a significant decrease in deaths from hypertensive disorders of pregnancy and anesthesia-related causes. Changes in the health system and improved obstetric care may be responsible. From the mid-1990, there was an increase in budgetary allocation to health, especially maternity services which led to both a better equipped hospital as well as improved staffing.

Hypertension, which is one of the most common severe complications of pregnancy, remains a leading cause of fetal and maternal mortality.¹³ The incidence of this medical disorder in low-income countries is about 30%, and in about 40-50% of cases, the

condition becomes severe.¹⁴ In this series, the fall in deaths from hypertension is likely to be due to greater vigilance in measuring blood pressure at the primary level and prompt referral to the tertiary institution, aggressive management of severe hypertension with either hydralazine or nifedipine, early recourse to magnesium sulphate prophylaxis against eclampsia, and timely delivery. Adherence to international guidelines and local protocols became more common from the year 2000 onwards. Furthermore, widespread administration of calcium for prevention of pre-eclampsia was implemented. This practice was born out of a local study which showed that calcium was more efficacious than low-dose aspirin in the prophylaxis against pre-eclampsia.¹⁵ Later, a systematic review comprising of 12 studies revealed that women deemed high risk for pre-eclampsia, as well as those with low baseline dietary calcium intake had the greatest protection.¹⁶ We recommend that the care of women with severe pre-eclampsia, especially early-onset disease, should be centralized and administered by an experienced, dedicated, multidisciplinary team.¹⁵

Major gains were revealed with anesthesia-related deaths with no losses recorded in the second half of the investigation. A possible explanation for this is a change in policy when it became mandatory in the late 1990s that anesthesia for high risk cases such as severe pre-eclampsia or morbidly obese women had to be administered with the consultant or registrar in attendance. Another change in policy was the almost complete replacement of general anesthesia by regional block for Cesarean sections.

Obstetric hemorrhage which is the leading cause of maternal demise internationally, accounted for 9 deaths in this series. A 50% decline was evident in the second half of the study. This is attributable to better blood banking services, and earlier recourse to surgery with major postpartum hemorrhage unresponsive to medical treatment. In the UK, this condition occurs in about 3.7 per 1000 live births.⁷ The number of deaths from hemorrhage may be reduced further with improvement in the quality and safety of care, regular drills, and skills exercises, and closer multidisciplinary working. The latter continues to be a nightmare among developing countries with lack of an on-call hematologist and/or well-equipped blood banking service.

With the rising tide in Cesarean section rates locally, from 2.2% to 6.6% during the decade 1976 to 1985,¹⁷ and further increase thereafter to a rate of 20% in 2003,¹⁸ with continued rises to as high as 30% based on hospital records, there has been an increase in maternal deaths from pulmonary embolism in the latter three intervals. Other associated risk factors were advanced maternal age, especially among patients 40 years and over, obesity and African ethnicity. The need for better risk assessment, adequate thromboprophylaxis, prompt investigation of chest symptoms, and involvement of a multidisciplinary team is advocated.¹⁹

A limitation of this study is that it is hospital based, but it is fair to extrapolate the findings to the entire country in view of the central location of the institution. In addition, the population served is representative of the country overall. Although the MMR reported in this analysis is less than the estimated rate for the entire country, a similar trend of a falling rate is evident worldwide since 2000. Strength of this enquiry is that all deaths were cross-checked at the Registrar General Department, Ministry of Legal Affairs in order to complete data analysis.

This investigation highlights the fact that maternal mishaps

including death remain a major burden to society, especially in low and medium resource countries. Women, who are under-educated, live in an impoverished environment, are obese, belong to certain ethnic backgrounds, and have co-morbid conditions such as hypertension, stand a much higher chance of dying in pregnancy and childbirth. That better outcome in the second half of the enquiry was evident lends testimony to the fact that investment in health would bear fruits with improved pregnancy outcome. Although major strides have been achieved, better results are possible if attention is focused on addressing inequalities in access to, and quality of reproductive and newborn healthcare services; ensuring universal health coverage for comprehensive reproductive, maternal and newborn healthcare; addressing all causes of maternal mortality, reproductive and maternal morbidities; strengthening health systems to collect high quality data; ensuring accountability in order to improve high quality data; ensuring accountability in order to improve quality of care and equity, capacity, and strengthening efforts to improve the quality of recording,²⁰ reporting and geographical coverage of burden of disease will increase the robustness of future estimates.²¹

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None.

Conflicts of interest

The authors have no conflicts of interest to report.

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