

MATERNAL MORTALITY; AN ANALYSIS OF THE DETERMINANTS AND CAUSES

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ABSTRACT... **Objective:** The women residing in a developing country have 200 times greater risk of suffering from pregnancy and childbirth related mortality compared with the women of a developed country. To investigate relevant causes and the determinants of maternal mortality through conducting scientific clinical studies. **Methodologies:** We conducted a prospective study of maternal deaths in the obstetrics and gynaecology unit of RGH for one year. **Period:** January 2007 to December 2007. We investigated the socio-demographic variables -- including age, parity, socio-economic status and literacy -- along with the social behavior towards the antenatal. We designed standardized data collecting forms to collect data from the confidential hospital notes of the patients. The collected medical data of the patients proved useful in analyzing the underlying causes and the risk factors behind direct and indirect maternal mortalities. **Results:** In our unit, we have recorded 28 maternal deaths during the study period. 24 (86%) deaths are due to the direct causes and 4 (14%) are due to the indirect causes. The leading direct causes are hemorrhage 9 (37.5%), eclampsia 7 (29%), septicemia 5 (21%) and anaesthesia complications 2 (8%). Similarly, the distribution of indirect causes is: blood transfusion reactions 2 (50%), hepatic failure 2 (50%), Consequently, crude maternal mortality rate can be extrapolated at 645 per 100,000 maternities and maternal mortality ratio at 659 per 100,000 live births. The socio demographics of the dead mothers are: 16 (57%) patients in the age group of 25-35 years, 13 (52%) are multiparas (G2-G4) and 10 (36%) are grandmulti para i.e. G5 and above. Moreover, 13 (46%) of them expired at term. The majority of them is illiterate and belongs to lower socio-economic group. 14 (42%) mothers have not received antenatal care and just 4 (15%) of them have received antenatal care from RGH or other hospital. 23 (92%) patients have been suffering from anemia and we received 15 (54%) of them in a critical state with the hospital stay of less than 12 hours. **Conclusion:** In our study hemorrhage and hypertensive disorders of pregnancy are the leading causes of maternal deaths. We argue that most of these maternal deaths could have been possibly avoided by periodic interventions during the pregnancy, child birth and the postpartum period.

INTRODUCTION

Pregnancy is defined as a normal, healthy state that most women aspire at some point in their lives. Pregnancy and childbirth must be an occasion of rejoice and happiness for the mother and her family, but it could lead to a nightmare scenario because of mother's or child's mortality due to pregnancy related complications. Every year, more than 500,000 women die mostly from

treatable complications of pregnancy and childbirth, and in addition to this a significant number of them are permanently disabled¹.

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Approximately 99% of these deaths occur in the developing countries. According to World Health Organization (WHO), the maternal mortality rate in South East Asia in 2000 was estimated to be 460 per 100,000 live births². Moreover, the lifetime risk of a women suffering from the maternal death is 1 in 58². The maternal mortality ratio (MMR) in Pakistan is estimated approximately 340 per 100,000 live births³. To reduce MMR globally by 70% by the year 2015 is one of the Millennium Development Goals (MDGs) set by World Health Organization (WHO)⁴. The United Nations has simply adopted this MDG.

The direct causes of maternal mortality dominate in developing countries – including but not limited to hemorrhage, hypertension, infection, obstructed labour, and unsafe abortion⁵. In comparison, in developed countries the direct causes for maternal mortality are continuously declining. See⁶ to get an insight about the case study of the UK. The likelihood that a pregnant woman will survive because of high risk complications depends not only on her complication but also on her general health status, the quality of maternal care facilities and availability of skilled health care staff. The MMR is a macro indicator about the quality of health care, provided to a woman during pregnancy, childbirth and the postpartum period⁷. Therefore, it is a standard practice in the renowned women hospitals of developed countries to conduct their annual mortality audit to have a continuous evidence based feedback that helps in not only evaluating the quality of their maternal care but also efficacy and efficiency of their hospital protocols in handling high risk patients. As a consequence, they can continuously improve their clinical guidelines and protocols to combat maternal mortality. In line with this standard practice, we present the annual audit of maternal deaths in RGH specifically focusing on the determinants and causes of these maternal deaths.

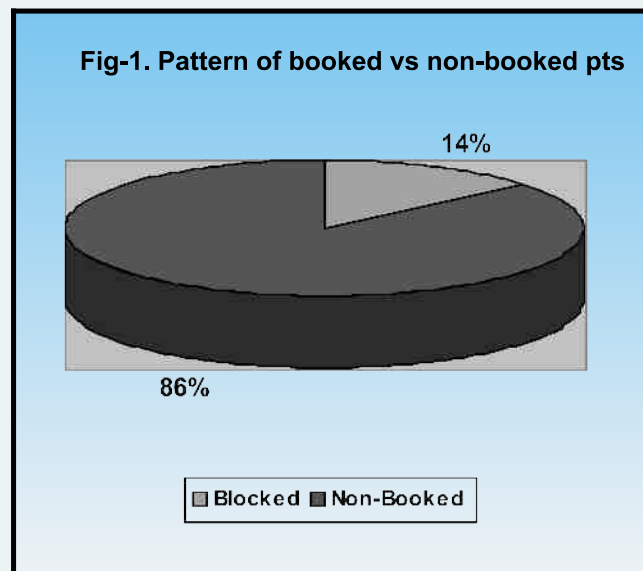
METHODOLOGY

The prospective maternal mortality audit is an outcome of evidence based clinical study that is conducted in obstetrics and gynaecology unit of RGH during the year 2007. We followed WHO definition of maternal death that includes only direct and indirect maternal deaths.

Consequently, the deaths due to co-incidental causes are excluded. All mothers delivered in RGH during this period are included to calculate MMR. The information is obtained on specially designed study forms from the confidential hospital records of the expired patients. More specifically, we discuss whether the patients sought antenatal care, their risk factors and length of their hospital stay. We also report a number of related socio demographic factors like age, parity, household income and education status.

RESULTS

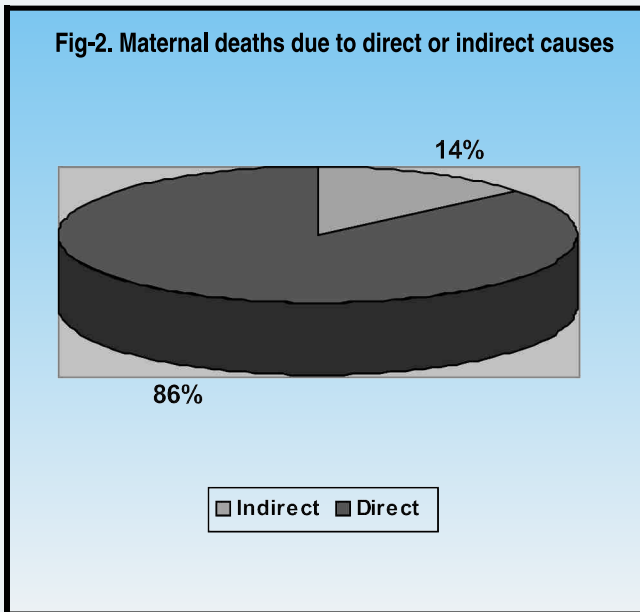
In the year 2007, 28 mothers died in RGH. Note that the total number of deliveries in the same year was 4340. If we take the ratio of deaths to the deliveries and then linearly extrapolate the number, we get an estimated MMR of 659 per 100,000 live births. Among the dead, only 4 (14%) sought antenatal care from a health care center (Basic or hospital); while remaining 24 (86%) virtually never thought it appropriate to pay antenatal visits (see Figure 1).



An intricate web of factors keep the pregnant women away from available health services like familial taboos, illiteracy, poverty and poor transportation system to the nearest basic health units.

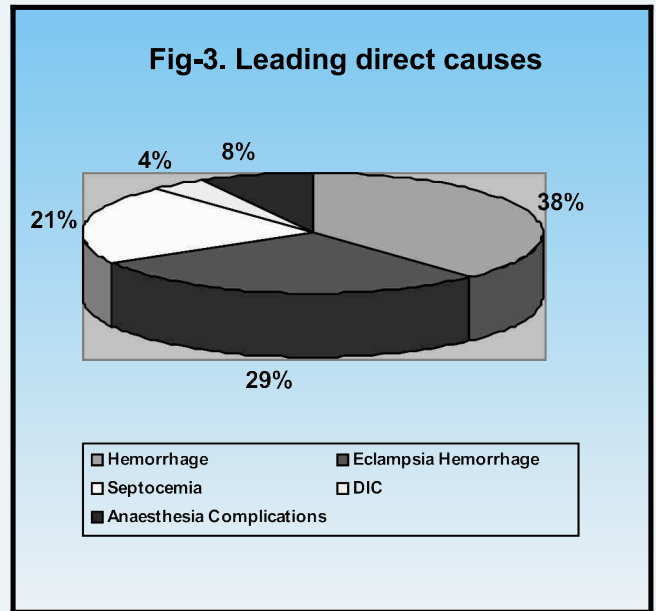
Causes of maternal mortality

Maternal death, is defined by WHO as “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 causes”. In our sample, 24 (86%) are attributable to direct classic obstetric indicators and remaining 4 (14%) are because of indirect non-obstetric indicators (see Figure 2).



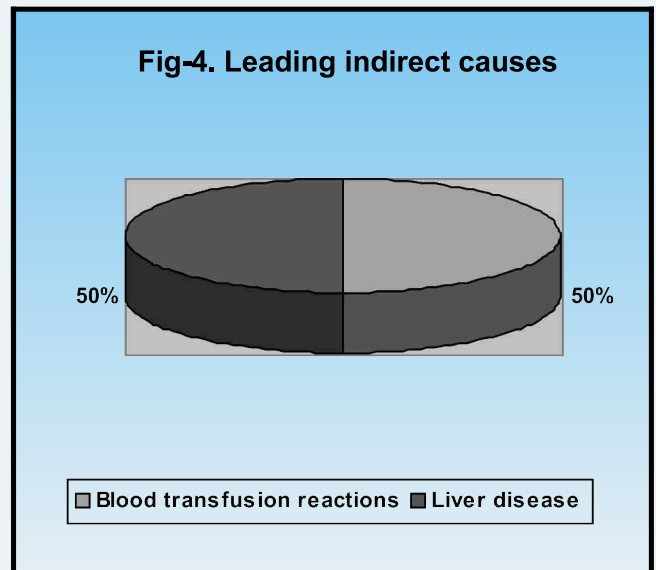
Direct causes of maternal mortality

The most of direct causes are complex but correlated and are possibly preventable. The major cause is hemorrhage 9 (37.5%). 5 patients out of them came with antepartum hemorrhage (APH- 3 abruptions,2 placenta previa) and 4 patients reported with post partum hemorrhage (PPH). The other leading causes are shown in Figure 3: (1) eclampsia +multiorgan failure+HELLP 7 (29%), (2) septicemia 5 (21%) in which 4 cases are of puerperal sepsis and 1 of septic induced abortion, (3) anaesthesia complications 2 (8%) and (4) remaining one patient is of disseminated intravascular coagulation (DIC).



Indirect causes of maternal mortality

In our study 4 patients died because of indirect causes (see Figure 4).



The important causes are: blood transfusion reactions 2 (50%) and hepatic failure 2 (50%). This trend is in sharp contrast to the pattern reported in “The Confidential Inquiry into Maternal Deaths (CEMD) 1999-2002”⁶ in which it was revealed that for the first time in UK deaths due to indirect causes exceeded the number due to direct ones.

Comparison of causes of maternal mortality

We have already shown that MMR in rich and poor countries shows a significant variation. In⁸, it is shown that Post-partum hemorrhage, eclampsia and sepsis are the leading causes for maternal deaths in developing countries. Confidential Enquiry into Maternal and Child Health (CEMACH) (2003-2005) study conducted in the UK showed the major contributor of maternal death is cardiac related disorders⁹ and interestingly only few patients died because of hemorrhage, anaesthesia, and uterine trauma – the common causes in developing countries.

Table-I. A comparative tabulation of causes of maternal deaths in different studies

WHO	CEMACH (UK)	RGH.
Hemorrhage (25%)	Thromboembolism	Hemorrhage (32%)
Indirect (20%)	Sepsis	Eclampsia + HELLP + multiorgan failure (25%)
Sepsis (15%)	Pre-eclampsia	Septicemia (17%)
Unsafe abortion (13%)	Amniotic fluid embolism	Anaesthesia complication (7%)
Eclampsia (12%)	Indirect causes	Blood transfusion reaction (7%)
Obstructed labour (8%)	-	Hepatic failure (7%)
Other direct causes (8%)	-	DIC (3.5%)

We now show interesting insights of our study in Tables 2 – 10.

Table-II. In our audit 22 (78%) patients are in the age group of 20-35 years. The reason is that in Pakistan, most of women have their maternities in this age group. Generally, it is also the peak of a woman's reproductive life. The CEMD (1999-2002) shows a significant increase in risk of mother's death if they are less than 18 years. Similarly, increasing maternal age and parity result in high chance of a mother's death.

Age group	<20yrs	20-25yrs	25-30yrs	30-35yrs	>35yrs
No:	1	6	12	4	5
%	3.5	21	43	14.5	18

Table-III. Increasing parity is in itself a risk factor for a mother especially if she belongs to a poor family that cannot afford healthy nutrition for her. The females of the reproductive age group should be reached at their door steps to encourage contraception and to have reasonable gaps between children.

Parity	Unmarried	PG	G2-G4	G5-G8	G8 and more
No:	1	5	12	8	2
%	3.5	18	43	28	7.5

Table-IV. It is interesting to note that 61% of the maternal deaths are from low income families with a monthly income of less than PKR 5000 per month. This trend is inline with the outcome of CEMACH study that concludes that poor women are seven times more likely to suffer compared with women belonging to high income group.

Socioeconomic status (Income per month)	<5000 Poor	5-10 Lower middle	>10 Upper middle
No:	17	8	3
%	61	28.5	10.5

Tables-V. This table further validates results of existing studies that the major underlying problems contributing to high rate of maternal mortality are poverty, malnutrition and lack of education. Out of 28 maternal deaths, 23 women are simply illiterate, only 4 are matriculate and just 1 of them is intermediate or above.

Educational status	Un-educated	Matriculation	Intermediate and above
No:	23	4	1
%	82	14.5	3.5

Table-VI. This table compliments the data in Table 5 that 26 women are housewives and only 1 of them was doing job while 1 was still a student.

Occupation	House wife	Job	Student
No:	26	1	1
%	93	3.5	4

Table-VII. It is clear that 92 % of patients are anemic and some of them even have more than one risk factor. These women are relatively more vulnerable to adverse pregnancy outcomes. This further confirms that only healthy mothers will have healthy pregnancies that ultimately lead to healthy babies.

Risk factor	Anemia	Previous caesarean	Placenta previa	Intra uterine death
No:	23	2	3	4
%	92	8	12	16

Table-VIII. We can see that approximately 46% of the patients are at term. 21% and 5% of them died during third trimester and postnatal period respectively. The obvious pattern is that patients are brought into hospitals for the first time when a complication occurs at the time of delivery. The physicians are hardly left with an option to do any effective management in such a critical condition.

Gestation in weeks	1 st trimester till 14weeks	2 nd trimester 14-24weeks	3 rd trimester 24-37weeks	Term 37-42weeks	Postnatal
No:	2	2	6	13	5
%	7.5%	7.5%	21%	46%	18%

Table-IX. It is clear that approximately 43% of patients have arrived in a critical condition in our hospital. In case of unconscious and comatose patients (29%) the physicians are left with no options. We argue that an early warning system, suggested by CEMACH study⁹, is of great importance in timely recognition, treatment and referral of women developing critical conditions.

Condition on arrival	Conscious and stable	Drowsy and compromised	Unconscious and critical	Comatose and irreversible
No:	16	4	5	3
	57	14	18	11

Table-X. In the last table, we show that 50% of patients expired within first 12 hours of their hospital stay. This further confirms that late referrals to tertiary care hospitals and the decision of the family members to seek late medical advice contribute to this unfortunate scenario. By training midwives and educating members of the family through the lady health workers network, we can definitely make a difference in these numbers.

Total stay in hospital	1-2hrs	12hrs	12-24hrs	>24hrs
No:	4	10	2	12
%	14	36	7	43

DISCUSSION

Maternal mortality affects not only the pregnant women, but also their families and communities. Therefore, it is an important measure that defines the quality of maternity care^{10,11}. On the contrary, it is surprising to see that maternal mortality is one of the most neglected issues in the health care system of developing countries. For example the difference in maternal mortality between rich (mortality risk 1 in 4000-10,000) and poor countries (mortality risk 1 in 15-50) is definitely very high⁸. This alarming difference demands that its causes should be scientifically investigated with an objective to develop evidence based national guidelines to reduce MMR. Such studies also help in developing national level strategic maternal health care framework that will result in preventing most of the pregnancy related mortality and morbidity¹². It does not give good feeling to learn the reasons, mostly preventable, behind why mothers die. The majority of mothers die because of their lack of knowledge related to pregnancy, unawareness among women about the importance of antenatal visits and the importance of general health, nutrition and diet. Consequently, these factors – coupled with illiteracy and low income – ultimately lead to high risk factors that could have been easily avoided¹³.

In Pakistan, it is very difficult to estimate maternal mortality ratio because of major methodological related challenges in designing scientific studies or surveys to measure MMR¹⁴ because statistically significant data is either inadequate or altogether missing^{15,16}. Most of the studies, even though may not be statistically significant, still show a pattern that post partum hemorrhage, eclampsia and sepsis are the leading causes for maternal deaths in the developing countries⁸. According to the SOGP survey (1989-1990), the most common causes of maternal mortality are: hemorrhage (21%), hypertensive disease (18.6%), sepsis (13.3%), abortion (11%) and others (36%)¹⁷.

Our study is definitely done on a limited sample set of just 28 deaths but to a larger extent, it supports the results of above mentioned studies. In our case, the crude maternal mortality rate is 645 per 100,000 maternities and estimated maternal mortality ratio (MMR)

is 659 per 100,000 live births – a little higher than the national average of 340 per 100,000 live births³. The maternal mortality audit of Bolan Medical Complex hospital Quetta, Pakistan also reports a MMR of 557 per 100,000 live births¹⁸. Similarly MMR of Civil Hospital Karachi is reported at 550 per 100,000 live births during the year 2005-2008¹⁹. We, however, would like to emphasize the fact that MMR at these tertiary hospitals do not reflect the true national MMR because these hospitals mostly receive critical patients referred from the periphery. The low risk patients are mostly delivered at home by either untrained birth attendants or trained birth attendants. In a best case scenario they are delivered in a periphery basic health center by LHV's or lady doctors. A common pattern that emerges among these studies is: the major causes of maternal deaths are hemorrhage, hypertensive disorders and sepsis -- same trend is revealed in our study as well. In addition the women are also subject to domestic violence and substance abuse. These numbers are alarmingly high when compared with MMR of just 14 per 100,000 live births in the UK, reported by CEMACH (2003-2005)⁹.

In our study the leading direct cause is hemorrhage which again concurs with the fact that it is also the dominating cause of maternal deaths world wide, especially in Africa and Asia²⁰. Researchers use the term 'hemorrhage' to also include multiple etiologies. Most maternal deaths due to hemorrhage occur because of failure of the system to recognize the importance of intervening efficiently and promptly²¹. The next important cause of maternal deaths is hypertensive disorders in our study. It is interesting to note that this is the most dominating cause of maternal deaths in Latin America and the Caribbean region as well²⁰. To conclude, it is very important to standardize and implement universal protocols in these countries that help detecting these disorders at an earlier stage of pregnancy and then doing their efficient and effective management²⁰.

The third dominating cause of maternal deaths in our study is septicemia. The studies conducted by WHO estimate that one in eight pregnancy related deaths results from unsafe abortions²². This figure is definitely underestimated as in most countries abortions are illegal

which makes it impossible to officially document these deaths²³. The studies suggest that 100,000-200,000 maternal deaths out of 500,000 total deaths are related to unsafe illegal abortions. This definitely calls for formulating policies for antibiotic prophylaxis. The deaths related to abortion in UK is on the decline because of its legalization by the government; as a result, hospitals are better prepared to provide appropriate post-abortion care to avoid abortion related complications²⁴. In addition to this, the health care system should also encourage the use of contraception to reduce the risk of having abortion. To conclude, researchers believe that 26% of these deaths could have been prevented by introducing community based antenatal processes and interventions²⁰.

Now we focus our attention to indirect causes which are responsible for approximately 6.2% maternal deaths in our study. The dominant causes are blood transfusion reactions and hepatic diseases. In order to minimize these risks, we need to adopt multidisciplinary approach: a patient safety team – including physicians and experts from blood bank and nursing staff – can play a significant role to reduce deaths due to these indirect causes²⁵.

Another important conclusion of our study is that the frequency of maternal deaths increases with increasing age, high parity, low socio-economic status, illiteracy, and other social economic indicators of pregnant women. This is inline with a recent study in the US that suggests that maternal deaths increase with an increase in parity and age of mothers²⁶. Moreover, CEMD study also suggests that women of underprivileged low income groups are 20 times more likely to die than literate women of relatively higher income groups. These findings suggest the importance of having a nation wide planned system of antenatal visits. Such visits also provide an opportunity to educate women about the risks of pregnancy and their possible countermeasure in their social context. Moreover, they can also get psychotherapeutic treatment of their social problems as well. This strategy confirms to the one proposed by CDC (US Center for Disease Control and Prevention) which, if truly implemented, suggests that MMR can be simply reduced to half by providing better access to prenatal care, quality of

maternal care and improving the standard of life. They have cited that in Sri Lanka such a strategy has resulted in unprecedented decrease in MMR from 1500 deaths per 100,000 live births to 300 per 100,000 live births in the last 25 years. They have simply focused on quality midwifery care and on eradication of malaria²⁷. In this way, they have been able to educate women about role of malnutrition and malaria. Moreover, they can also counter anemia and general debilitation because of infestation with intestinal parasites – significantly improving the ability of women to cope with complications in pregnancy. The outcomes confirm WHO findings: 4 to 6 planned antenatal care visits (ANC) by midwives are sufficient to provide effective and timely interventions²⁸ both for low and high risk patients.

Just to show that MMR pattern is same in other developing/neighbor countries, we also compare our situation with neighboring India. The figure of MMR in India stands at an abysmal 450 per 100,000 live births. However, the value has been reduced from 540 per 100,000 live births in 1998-1999. This gloomy picture shows that India too – according to UNICEF - is no way near to its MDG goal of 109 per 100,000. Maternal deaths are avoidable with the help of skilled health personnel, adequate nutrition, better medical and family planning facilities. Women's food intake across South Asia must improve if the region's high maternal mortality rate is to drop. More than half of Indian women have anaemia – a dominating factor contributing towards their death during the delivery process. (In comparison, only 24% of Indian men are anemic.) To conclude malnutrition and anaemia are also the dominating factors contributing towards MMR in India²⁹.

CONCLUSION

Maternal Mortality is a global challenge especially in developing countries, where MMR is almost a factor of 200 times higher compared with that of UK. Most of these deaths in developing countries occur because of direct causes. The problem is recognized by UN and therefore they have set an MDG to reduce it by 70% by the year 2015^{30,31}. In order to achieve this objective, we need to develop efficient and effective antenatal care (ANC) system in order to raise an early alarm for high

risk patients. These patients can be then put under greater observation that could ultimately lead to their early referrals – avoiding delays in their management at a hospital. In order to develop such systems, we need to first understand the major causes of maternal death. A recent study of WHO highlights the importance of maternal death review in reducing maternal mortality³². Our current study is motivated with this objective.

The outcome of our study is that access to quality, essential obstetric care can prevent maternal deaths. We need to improve health services at all the three levels of health system -- primary, secondary and tertiary care. Emergency obstetrical care must be made available to the women 24 hours a day seven days a week. The trained lady health workers to provide antenatal care services at the doorstep of pregnant women can play a vital role in reducing MMR, especially in underprivileged remote areas of Pakistan. Therefore, we also need to invest substantially in training of lady health workers and trained birth attendants in order to reduce MMR – an indicator reflecting the quality of maternal care of a country. Only healthy mothers can give birth to a future healthy generation.

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