

Estimation of Maternal Mortality through Excess Fertility and Percentage of Safe Delivery in Higher Age

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ABSTRACT

The level of maternal mortality is an indicator of disparity in access to appropriate health care and nutrition services throughout their life particularly during pregnancy and childbirth. National Population Policy 2000 and National Health Policy 2002 aim to reduce the Maternal Mortality Rate (MM Rate) to 100 per 100,000 live births from the current level of 400-500. Though India has made an appreciable progress in improving the overall health status of its population but it is far from satisfaction. The pace of decline of maternal mortality on has been quite low. The death of a woman during pregnancy and childbirth is not only a health issue but also a matter of social injustice and discrimination. The complications of pregnancies and the births are found to be the foremost causes of maternal deaths. This measure reflects not only the risk of maternal death per pregnancy, but also the level of fertility in a population. The fertility beyond age 35 years is risky for both women and child and it leads to miscarriage, maternal & child mortality thus the study of the fertility beyond 35 years of age is an important issue for the researchers to study the status of maternal and child health. In this paper a simple technique has been proposed to estimate the MM Rate and MM Ratio using the age specific fertility rate (ASFR) and percentage of safe delivery beyond 35 years of age respectively, keeping in view of the above fact.

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Introduction

In most of South Asia, complications of pregnancy and childbirth are believed to be the leading cause of death among women of reproductive age. The maternal mortality measure is considered a sensitive index of the prevailing health conditions and general socioeconomic development of a community. The exact ascertainment of the situation could be monitored with the availability of MM Rate and MM ratio estimate and causes of maternal deaths. Maternal mortality refers to the death of a woman while pregnant or within 1.5 months of the termination of pregnancy, irrespective of the gestation period, from any cause motivated by the pregnancy and its management but not from accidental or incidental causes (WHO, 2004). MM Rate can be calculated by dividing the total deaths by the total births during the year. MM Ratio measures number of Women aged 15-49 years dying due to maternal causes per 1,00,000 live births. The paper estimates the MM Rate, using ASFR and estimate of MM Ratio using, percentage of safe delivery beyond 35 years of age, from secondary data source through linear and log linear regression technique respectively. It is worthwhile to mention here the relationship between MM Rate and ASFR follows U shaped i.e. in early and late age group there is high risk but in middle age group maternal death is almost uniform. According to medical science, Pregnancy in woman after 35 years old is associated with a higher maternal death as well as child death. For example Diabetes and hypertension increase almost linearly with age. Pregnant women with diabetes or hypertension are at increased risk of adverse pregnancy

outcome irrespective of age. Most of complications associated with older age are caused by reproductive complications. All over the world women are delaying childbearing for various reasons. Pursuit of career or financial goals, better contraception, longer life expectancy, higher education etc, have been mentioned as possible reasons for this phenomenon. It may also be observed that increase in safe deliveries is reflected through decline in maternal deaths. Safe delivery refers to that the birth assisted by a skilled attendant.

Blum and Fargues (1990) appear to underestimate the significance of mortality from accidents and violence among adults in developing countries. As studies of India and China indicate homicide, accidental fire, and suicide are major causes of mortality among women of reproductive age in Asia (Bhat 1992). Although fewer motor vehicles are driven in developing countries, poor road conditions, lack of safety regulations, and overcrowding result in a substantial number of fatal vehicular accidents. Therefore, Blum's and Fargues's assumption, that once maternal mortality is removed, the age profile of female mortality or the ratio of women's to men's mortality would have a more regular pattern, is incorrect. Indeed, their two methods probably give different estimates of maternal mortality because of the varying sensitivity of the methods to the disturbances from accidents. Studies in Family Planning Blum and Fargues appear to underestimate the significance of mortality from accidents and violence among adults in developing countries.

The results of large-scale survey have however shown that there was no decline in maternal mortality over time

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indicating an urgent public health concern. The complications of pregnancies and the births are found to be the leading causes of deaths and disability among women of reproductive age. The health problems of mothers and newborns arise as a result of synergistic effects of malnutrition, poverty, illiteracy, unhygienic living conditions, infections and unregulated fertility. At the same time, poor infrastructure and ineffective public health services is also responsible for low inadequate obstetric care. The exact ascertainment of the situation could be monitored with the availability of MM Rate and MM Ratio estimate and causes of maternal deaths. Bharti et al. (2002) has conducted a study in Rural North to estimates of maternal mortality and its related causes to ascertain the epidemiological factors which were associated with maternal deaths.

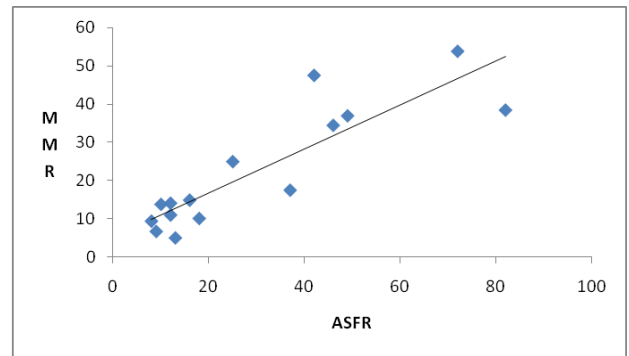
The importance of quantifying the loss of life caused by maternal mortality in a population is widely recognized. The maternal deaths being a rare event require prohibitively large sample size to provide robust estimates. In order to enhance a linear and log linear regression technique for the estimation of MM Rate and MM Ratio using the ASFR and percentage of safe deliveries after age 35 respectively. In India there is lack of right information on maternal mortality because of deaths may not be registered and also in some cases death not be identified as a maternal death. There is great need to estimate maternal mortality because of absence of data in this regard. Chauhan (2011) ASFR and unsafe deliveries (after age 35) likely to be associated with maternal death because women having late child birth are expected to be more aware of life threatening risks. The objective of this paper is to provide an update of our current knowledge about the impact of maternal age on maternal mortality. In this paper with the help of linear and log linear regression technique we are able to predict better estimate of maternal deaths of all states of India. The method of estimation described here is well-suited to the data circumstances in India.

Data and Methodology

Demographers always face problems due to non-availability of complete and reliable data. The estimation of maternal mortality requires specifically devise data gathering efforts. Approaches to measure maternal mortality range from vital registration system, household sample surveys and through census. Census in India does not include question on maternal death. The situation of vital registration is very poor in India. So, In lieu of using data from any direct source, indirect estimation for this phenomenon is preferable. For this analysis we carried out to the data from the secondary sources viz. NFHS III and SRS bulletins of 15 major states of India. In the present study data has been extracted for late ASFR (after age 35) and percentage of safe delivery after age 35 from NFHS III .On the basis of this relationship we are able to provide MM Rate and MM Ratio of all states of India.

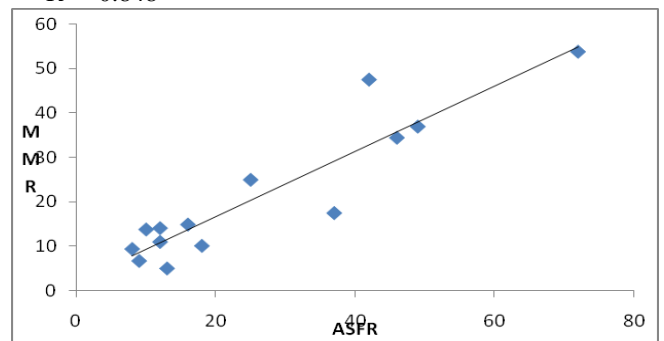
Model 1

Using regression analysis concept, Firstly the relationship between late ASFR and MMRate has been established. Where line of regression between ASFR (X) and MMRate (Y) is drawn. Its equation is $\hat{Y} = 0.579 * X + 5.092$
 $R^2 = 0.762$

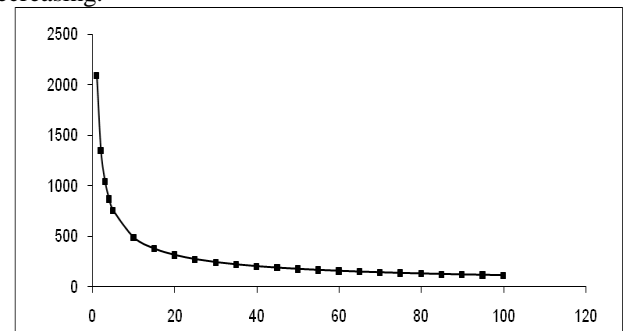


Model 2

After excluding Bihar the equations becomes $\hat{Y} = 0.736 * X + 1.96$
 $R^2 = 0.848$

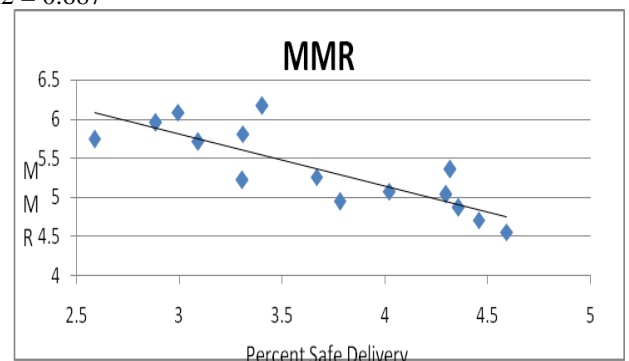


The maternal complications addressed comprise postpartum haemorrhage, obstructed labour, genital sepsis, pregnancy-induced hypertension/eclampsia and cerebral malaria. Among them postpartum haemorrhage and obstructed labour have been given more attention than the others. So here we endeavor to find the relationship between safe delivery after age 35 and maternal mortality and it is revealed in graph that as percentage of safe delivery is increasing MMR is decreasing.



Model 3

The model proposed is a log regression equation through which we can estimate maternal mortality ratio where Y is estimated MM Ratio and X is percentage of safe delivery. $\ln(\hat{Y}) = 7.807 - 0.664 * \ln(X)$
 $R^2 = 0.687$

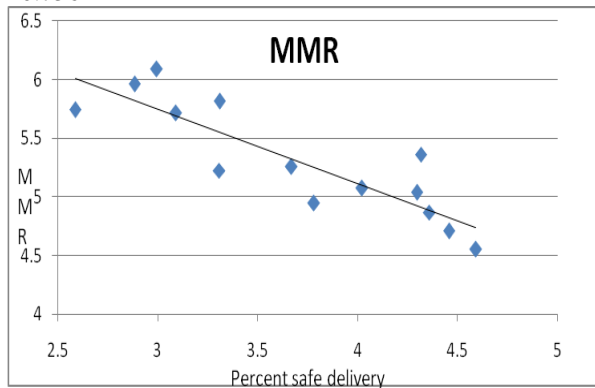


Model 4

After excluding Assam the equation becomes

$$\ln(\hat{Y}) = 7.646 - 0.632 * \ln(X)$$

$$R^2 = 0.756$$

**Discussions**

The estimated MM Rate of 15 major states of India whose MMR also given in SRS bulletin and comparison of estimated MM Rate with observed ones was done in Table 1. Here estimated MM Rate is almost equal to observed MM Rate except in Bihar. In Bihar the variation is high between observed and estimated MM Rate. Bihar stands here as outlier. In Bihar maternal mortality is low still there women have excess fertility. Main reason behind this output the working behavior of female such as the their contribution in agriculture and fooding behavior, female of Bihar take gudh, spinach and green leafy vegetables which is full of iron, several Vitamins, minerals and complex carbohydrates which give full energy. This is main reason that after having excess fertility, maternal deaths are comparatively less.

Table 2 presents the estimated MM Rate using ASFR according to different socio demographic variables. Although over the years, there has been steady progress in reduction in maternal mortality, there are substantial inequalities by asset quintiles, education of mother, place of residence, caste and

religion. MMR is likely to be higher in rural than in urban areas, keeping other factors constant, because the latter has the disproportionate concentration of health facilities with midwifery services. These facilities are few and far between in rural areas. In respect of religion MM Rate is higher in Muslim as compared to Hindu due to education level and high fertility in Muslim. Also we can see variation according to caste there is highest MM Rate in ST then it becomes less in SC and lowest in OBC.

Socio-economic status (SES) of a household is likely to be inversely associated with MM Rate because mothers of well-off households are expected to be more aware of life threatening risks of pregnancies than mothers of poor households. One would expect to find an inverse relationship between education of mother and maternal mortality. The higher the level of education of a pregnant woman, the lower the chances of her death due to maternal/childbirth related complications. An educated pregnant woman is more likely to be aware of the complications of pregnancies and its consequences on life. Therefore she is expected to better manage her pregnancy in terms of seeking and utilizing antenatal and postnatal care services than her counterpart who has little or no formal education.

Table 3 presents the estimated MM Rate according to place of residence on the basis of Model1, Model2. The descending sequence of MM Rate in Urban and rural area is in Bihar, Uttar Pradesh and Madhya Pradesh and lowest MM Rate in rural area is in Maharashtra and in urban area it is in Tripura.

Table 4 and 5 shows the estimated MM Ratio of same states of India and comparison of MM Ratio with observed ones, according to different socio economic and place of residence respectively using Model 3 and Model 4.

Table 1. Estimated Maternal Mortality Rates using Age specific fertility Rate through Model 1 and Model 2

States	ASFR (per 1000 Women)	Observed (MMR)*	Estimated (MMR) (Model 1)	95%CI (Model 1)	Estimated (MMR) (Model 2)	95%CI (Model 2)
AS	46	34.40	31.72	(26.32-37.13)	35.82	(30.48-41.17)
BR	82	38.40	52.57	(41.58-63.56)	-	-
MP	49	36.90	33.46	(27.70-39.22)	38.03	(32.26-43.81)
OR	25	24.90	19.56	(15.02-24.12)	20.36	(16.65-24.08)
RJ	42	47.50	29.41	(24.40-34.42)	32.87	(28.07-37.69)
UP	72	53.80	46.78	(37.53-56.03)	54.95	(45.29-64.64)
AP	12	10.90	12.04	(6.38-17.69)	10.79	(6.14-15.44)
KA	12	14.00	12.04	(6.38-17.69)	10.79	(6.14-15.44)
KR	13	4.90	12.61	(7.08-18.56)	11.53	(6.99-16.07)
TN	9	6.60	10.30	(4.27-16.33)	8.58	(3.56-13.61)
GJ	16	14.80	14.36	(9.14-19.57)	13.74	(9.51-17.96)
HR	37	17.40	26.52	(21.87-31.16)	29.19	(24.95-33.45)
MH	8	9.30	9.72	(3.56-15.89)	7.85	(2.69-13.01)
PB	10	13.70	10.88	(4.98-16.78)	9.32	(4.42-14.22)
WB	18	10.00	15.51	(10.49-20.53)	15.21	(11.16-19.26)

*SRS bulletin (2004-2006)

Table 2. Estimated Maternal Mortality Rates using Age specific fertility Rate according to different socio demographic variables in Uttar Pradesh

Variables		ASFR per 1000 Women	Estimated (MMR) (Model 1)	95%CI (Model 1)	Estimated (MMR) (Model 2)	95%CI (Model 2)
Type of Residence	Urban	40	28.35	(13.17- 43.34)	31.40	(17.21-45.59)
	Rural	85	54.31	(30.50- 78.12)	64.52	(41.51-87.53)
Religion	Hindu	65	42.72	(22.80- 62.66)	49.80	(30.71-68.89)
	Muslim	116	72.26	(42.43-102.09)	87.34	(58.25-116.42)
Caste	SC	100	62.99	(36.27- 89.72)	75.56	(49.61-101.51)
	ST	134	82.68	(49.36 -116.00)	100.59	(67.97-133.20)
	OBC	76	49.10	(27.03 - 71.17)	57.90	(36.65-79.14)
SLI	Low	143	87.89	(52.83 -122.96)	107.21	(72.83-141.59)
	Medium	78	50.25	(27.80 -72.71)	59.37	(37.73-81.01)
	High	27	20.73	(8.17-33.29)	21.83	(10.19-33.47)
Education	Illiterate	88	56.04	(31.65-80.44)	66.73	(43.13-90.33)
	Primary	53	35.78	(18.18-53.89)	40.97	(24.23-57.71)
	Secondary	30	22.46	(9.32-35.61)	24.04	(11.81-36.27)
	Higher	18	15.51	(4.70-26.33)	15.21	(5.33-25.09)

Table 3. Estimated Maternal Mortality Rates using Age specific fertility Rate according to residence in different states in India

States	ASFR (Urban)	MMR (Model 1)	95%CI (Model 1)	MMR (Model 2)	95%CI (Model 2)	ASFR (Rural)	MMR (Model 1)	95%CI (Model 1)	MMR (Model 2)	95%CI (Model 2)
India	18	15.51	(4.70-26.33)	15.21	(5.33-25.09)	44	30.57	(14.71-46.43)	34.34	(19.48-49.20)
Delhi	14	13.20	(3.16-23.24)	12.26	(3.17-21.36)	-	-	-	-	-
HR	18	15.51	(4.70-26.33)	15.21	(5.33-25.09)	46	31.73	(15.48-47.98)	35.87	(21.01-50.73)
HP	12	12.04	(2.39-21.70)	10.79	(2.09-19.50)	8	9.72	(0.85-18.60)	7.85	(-7.01-22.71)
JK	28	21.30	(8.55-34.06)	22.57	(10.73-34.40)	48	32.88	(16.25-49.52)	37.29	(22.43-52.15)
PB	9	10.30	(1.24-19.38)	8.58	(0.47-16.70)	11	11.46	(2.01-20.92)	10.06	(-4.80-24.92)
RJ	12	12.04	(2.39-21.70)	10.79	(2.09-19.50)	55	36.94	(18.95-54.93)	42.44	(27.58-57.30)
UT	13	12.62	(2.78-22.47)	11.53	(2.63-20.43)	22	17.83	(6.24-29.43)	18.15	(3.29-33.01)
CH	8	9.72	(0.85-18.60)	7.85	(-0.07-15.77)	48	32.88	(16.25-49.52)	37.29	(22.43-52.15)
MP	30	22.46	(9.32-35.61)	24.04	(11.81-36.27)	61	40.41	(21.26-59.57)	46.86	(32.00-61.72)
UP	42	29.41	(13.94- 44.89)	32.87	(18.29-47.45)	89	56.62	(32.04-81.22)	67.46	(52.60-82.32)
BR	54	36.36	(18.56-54.16)	41.70	(24.77-58.64)	96	60.68	(34.73-86.63)	72.62	(57.76-87.48)
JH	24	18.99	(7.01-30.97)	19.62	(8.57-30.68)	91	57.78	(32.81-82.76)	68.94	(54.08-83.80)
OR	14	13.20	(3.16-23.24)	12.26	(3.17-21.36)	28	21.30	(8.55-34.06)	22.57	(7.71-37.43)
WB	16	14.37	(3.93-24.79)	13.74	(4.25-23.22)	18	15.51	(4.70-26.33)	15.21	(0.35-30.07)
AS	14	13.20	(3.16-23.24)	12.26	(3.17-21.36)	56	37.52	(19.33-55.71)	43.18	(28.32-58.04)
Sikkim	7	9.15	(0.47-17.83)	7.11	(-0.61-14.83)	40	28.25	(13.17-43.34)	31.40	(16.54-46.26)
TR	6	8.57	(0.08-17.06)	6.38	(-1.15-13.90)	10	10.88	(1.62-20.34)	9.32	(-5.57-24.18)
GOA	27	20.73	(8.17-33.29)	21.83	(10.19-33.47)	40	28.25	(13.17-43.34)	31.40	(16.54-46.26)
GJ	13	12.62	(2.78-22.47)	11.53	(2.63-20.43)	18	15.51	(4.7-26.33)	15.21	(0.35-30.07)
MH	10	10.88	(2.78-22.47)	9.32	(1.01-17.63)	5	7.99	(-0.31-16.28)	5.64	(-9.22-20.50)
AP	7	9.15	(1.62-20.15)	7.11	(-0.61-14.83)	14	13.20	(3.16-23.24)	12.26	(-2.60-27.12)
KA	14	13.20	(3.16-23.24)	12.26	(3.17-21.36)	12	12.04	(2.39-21.70)	10.79	(-4.07-25.65)
KR	12	12.04	(2.39-21.70)	10.79	(2.09-19.50)	13	12.62	(2.78-22.47)	11.53	(-3.33-26.39)
TL	12	12.04	(2.39-21.70)	10.79	(2.09-19.50)	7	9.15	(0.47-17.83)	7.11	(-7.75-21.97)

Table 4. Estimated Maternal Mortality Ratio using percentage of safe delivery through Model 3 and Model 4

States	Safe delivery after age 35(%)	Observed (MM Ratio)*	Estimated (MM Ratio) (Model 1)	95%CI (Model 1)	Estimated (MM Ratio) (Model 2)	95%CI (Model 2)
AS	30.1	480	256.31	(213.63-307.36)	-	-
BR	13.3	312	440.85	(315.10-616.70)	407.15	(305.24-543.08)
MP	27.4	335	272.82	(224.83-330.90)	257.70	(217.82-304.88)
OR	22	303	315.62	(251.07-396.62)	296.10	(242.89-360.97)
RJ	17.9	388	361.95	(276.40-473.82)	337.38	(267.40-425.68)
UP	20	440	332.24	(262.66-430.29)	314.51	(254.07-389.33)
AP	73.5	154	141.68	(111.74-179.49)	138.01	(113.10-168.42)
KA	75	213	139.79	(109.83-177.79)	136.26	(111.31-166.81)
KR	98.7	95	116.50	(86.40-156.92)	114.53	(89.22-147.00)
TN	86.3	111	127.36	(97.25-166.63)	124.68	(99.50-156.24)
GJ	55.8	160	170.13	(140.39-206.00)	164.30	(139.63-193.33)
HR	27.3	186	273.48	(225.26-331.86)	258.30	(218.23-305.71)
MH	78.2	130	135.97	(105.95-174.34)	132.71	(107.68-163.55)
PB	39.2	192	215.08	(181.92-254.12)	205.44	(177.78-237.40)
WB	43.9	141	199.50	(168.31-236.32)	191.23	(165.26-227.28)

*SRS bulletin (2004-2006)

Table 5. Estimated Maternal Mortality Rates using percentage of safe delivery according to different socio demographic variables in Uttar Pradesh

Variables		% safe delivery after age 35	Estimated (MM Ratio) (Model 3)	95%CI (Model 3)	Estimated (MM Ratio) (Model 4)	95%CI (Model 4)
Type of Residence	Urban	36.6	225.11	(203.33-246.86)	215.03	(193.25-268.67)
	Rural	12.4	461.85	(440.07-483.63)	426.16	(404.38-505.41)
Religion	Hindu	20.1	335.13	(313.35-356.91)	314.05	(292.27-378.69)
	Muslim	19.0	347.89	(326.11-369.67)	325.42	(303.64-391.45)
Caste	SC	18.7	351.59	(329.81-373.37)	328.71	(306.93-395.14)
	ST	0	-	-	-	-
	OBC	15.9	391.57	(369.79-413.35)	364.19	(342.41-435.13)
SLI	Low	9.2	563.10	(541.32-584.88)	514.64	(492.86-606.66)
	Medium	13.0	447.59	(425.81-469.37)	413.62	(391.84-491.15)
	High	44.4	198.00	(176.22-219.78)	190.31	(168.53-241.56)
Education	Illiterate	13.9	428.13	(406.35-449.91)	396.49	(374.71-471.69)
	Primary	16.3	385.16	(363.38-406.94)	358.52	(336.74-428.72)
	Secondary	37.5	221.50	(199.72-243.28)	211.75	(189.97-265.06)
	Higher	96.4	118.33	(96.55-140.11)	116.59	(94.81-161.89)

Conclusion

In India data on maternal mortality is not easily available. The models provided here with the help of linear regression will be able to predict MM Rate. Out of two models, model 2 is able to predict 85% rate. From which we can provide a brief idea about maternal mortality. Here Bihar is odd one out due to the working and fooding style of women. Also it is observed that in all models even after putting ASFR equals to zero means no fertility after age 35, models still we will be able to provide maternal mortality which is during pregnancy period. Also using percentage of safe delivery we can predict 76% MM Ratio after excluding Assam. Estimated values are given in Table 4 and 5.

References

Bhat, P.N. Mari. 1991. "Mortality from accidents and violence in India and China." Research report, Minneapolis, MN: Center for Population Analysis and Policy, University of Minnesota.

Bhat, P.N. Mari, K. Navaneetham, and S.I. Irudaya Rajan. 1992. "Maternal mortality in India: Estimates from an econometric model." Paper presented at workshop on the Future of Health and Development in India, National Council for Applied Economic Research and Harvard Center for Population and Development Studies, New Delhi, 2-4 January.

Bhat Mari, P.N. Navaneetham, K. and Irudaya Rajan S., 1995, Maternal Mortality in India: Estimates from a regression model, *Studies in family Planning*, 26, 4 (July-August): 217-32.

Blum A and Fragues P .1990 " Rapid estimates of maternal mortality in countries with defective data" *Pop stud* 44:155-171.

IIPS, *National Family Health Survey, India 2005-06 (NFHS-III)*, Mumbai: International Institute for Population Sciences.

Rafiqul Huda Chaudhury "Multi-Sect Oral Determinants Of Maternal Mortality In Bangladesh" in the ESCAP region, 20-22 October 2008, Hefei, Anhui Province, China.

Chauhan R. K. (2011) "Maternal Mortality in Districts of Uttar Pradesh: An empirical Estimation" in *Population and Reproductive Health: Perspectives and Issues*, Hindustan Publishing Corporation, Edited by Ulimiri V. Somayajulu et.al, PP-31-42.

Registrar General, India, (2006), *Maternal Mortality in India: 1997-2003, Trends Causes and Risk factors*, Sample Registration System (SRS), New Delhi.

WHO, 2004, *Maternal Mortality in 2000: Estimates developed by WHO, UNICEF and UNFPA*. Geneva: WHO.