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Relationship between Various Components of Maternal Health Care Services with Maternal Mortality Ratio: An Ecological Study

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ABSTRACT

Introduction: Maternal mortality is an important indicator of health care system. Since more than three decades several programmes have been implemented to decrease maternal mortality. But it is disheartening that despite of it India couldn't achieve MDG target.[5]This may be due to poor utilization of services or limitation of resources.[8]In this contest if it can be known which services among all have more impact on maternal mortality, then by giving more focused attention on those, we can accelerate the decline in maternal mortality.

Objective: This study was conducted with objective to find out relationship between MMR and various components of maternal health care services.

Methodology: Secondary data were collected from Annual Health Survey 2012-13 reports of Govt. of India. Coverage of components of maternal services in total 284 districts of 9 states under AHS were compared with MMR in bivariate and binary logistic regression analysis in SPSS in community medicine department of MKCG medical college.

Results: 4 components antenatal care in pregnancy, USG in pregnancy, institutional delivery and JSY scheme to mothers were found to be significantly associated with MMR. **Conclusion**: Higher coverage of components like ante natal care in pregnancy, USG in ante natal period, institutional delivery and JSY scheme to mothers significantly associated with lower MMR. So these components of maternal services should get more focused attention to decline MMR rapidly.

Key words : Maternal mortality, Maternal health services, Sustainable developmental goal, Ecological study, Ante natal check up, JSY scheme**.**

INTRODUCTION

Maternal mortality is an important indicator of health care system. It is a reflection of woman's place in society. Since more than three decades many targets have been set to reduce the maternal death. Government of India has introduced a series of programmes like Child survival and Safe Motherhood Programme (1992), RCH I (1997), RCH II (1997), National Rural Health Mission (2005), National Health Mission (2013) to address maternal health.[1] In the year 2000 the global community issued 8 MDG (millennium developmental goal) in which MDG-5 concerned with reduction of maternal mortality by 75% by 2015.[2] Recently spearheaded by the united Nations, the SDG(sustainable developmental goal) were adopted in 2015 in which SDG-3 targeted to reduce maternal mortality to 70 per 100,000 live births by 2030.[3]

There are many causes for maternal death and most of the deaths are avoidable as the solutions to

prevent or manage complication are well known. So Government of India has implemented several programmes which include services for Women which can both directly and indirectly decrease maternal mortality. Antenatal care and postnatal care for pregnant women, Facilities for institutional delivery, family planning and financial assistance to needy pregnant mothers for institutional delivery are some examples of services given to women to reduce maternal mortality.[4] But it is disheartening that despite of such endeavours India couldn't achieve MDG target and lag behind.[5] India accounted for 19% i.e. roughly one third of global maternal deaths by 2010.[6] According to sample registration system, government of India report maternal mortality ratio is 167 in 2013 which is unacceptable high.[7] This may be due to poor utilization of services or poor implementation of the programmes or limitation of resources. In this contest if it can be known that which services among all have more impact on maternal mortality, then by giving more focus on those services we can accelerate the decline rate of maternal mortality.

There is scarcity of literature which studied relationship between components of maternal health services and maternal mortality. So this study aimed to derive the relationship between components of health services and maternal mortality ratio. In this study maternal mortality ratio was taken for comparison as it is an indicator in SDG. This study was conducted with objective to find out the relationship between MMR and various components of maternal health care services which are provided to mothers for promotion and protection of maternal health.

METHODS

This study was an ecological study. Prior to the study eethical clearance was obtained from Institutional ethical Committee of MKCG medical college, Berhampur. For this secondary data were collected from Annual health survey reports (AHS) of 2012-2013 published under the census, Ministry of Home affairs, Government of India.[8] Data were available in the public domain for use. The AHS is the Government of India's initiative which records district level health outcomes in the nine Empowered Action Group States shown in image 1. Despite being restricted to 9 States, the AHS is the largest demographic survey in the world.[8] (**Image 1)**

The latest AHS reported in 2012–2013 covered all the districts i.e. 284 of the nine states. The states are Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand. These states constitute about half of India's population and accounts for major portion of maternal death. AHS adopted uni-stage stratified simple random sample and surveyed total of 20.94 million population and 4.32 million households.[8]

Image 1: Nine Empowered Action Group (EAG) States under Annual Health Survey (AHS)

Percentages of Coverage of maternal health care services components in each district were obtained from AHS (2012-13) reports. Health care service Components were Married women registered for Ante natal care(ANC), mothers who received more than 3 ANC, mothers who received at least one TT injection during ANC, mothers who consumed Iron and folic acid (IFA) tablets for more than 100 days, mothers who underwent USG in ante natal period, mothers who received post natal care within 48hrs and 1 week of delivery, mother who availed financial assistance for delivery under Janani Surakhya Yojana (JSY), delivery at government and private institute, delivery at home by skilled birth personals, safe delivery, caesarean section out of total delivery conducted at government and private institutes. Percentages of coverage of all these variables were compared with maternal mortality ratio (MMR). Percentages of home delivery, mothers not receiving PNC and staying < 24 hrs at institute where delivery conducted were also analysed with MMR. As maternal mortality is a rare event and AHS estimated the MMR for a group of three to five geographically contiguous districts, here we attributed the estimated MMR to each district in the group. Safe delivery comprised of institutional deliveries and home deliveries conducted by doctors or nurses or ANM or LHV and did not include those attended by trained Dai. But trained Dai were included under skilled health

personnel along with doctors, nurses, ANM and LHV. JSY is a most important program under National Rural Health Mission, Govt. of India under which cash incentives are provided to mothers to deliver their babies in a health facility that is it aimed at promoting intuitional delivery. The scheme has been implemented in all the 9 EAG states since 2005.

STASTICSTICS

All data were compiled and analysed in SPSS (version 16) in department of Community Medicine, M.K.C.G. Medical College, Berhampur. Association between MMR and maternal health care services was first analysed by bivariate analysis. Bivariate correlation was estimated between MMR and each study variables. As MMR was came out to be normally distributed for all variables Pearson correlation coefficient values were found out. In the study *P* value less than 0.05 was taken as significant. Variables with P value < 0.05 in the bivariate analysis were retained in Logistic regression model. Regression analysis will show effect of each health services components on MMR in presence of other components.

RESULTS

(A) MMR in 9 EAG states

The present study included 284 districts of 9 states. Mean MMR of 9 states are presented in figure 1. MMR ranged from minimum 169 to maximum 292. MMR was highest in Assam where as it was lowest in Uttarakhand. Only Uttarakhand had MMR lower than 200, all other had MMR more than 200.

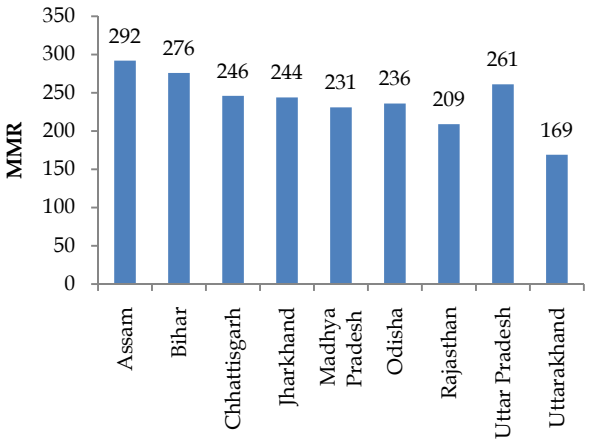

Fig 1: Bar diagram showing mean MMR of 9 nine Empowered Action group states (AHS 2012-13 reports)

Table 1: Components significantly correlated with MMR (P value < 0.05) in bivariate analysis

Correlates of MMR	Total*		Rural§		Urban¶	
	R value	**P value**	**R value**	**P value**	**R value**	**P value**
Negatively correlated with MMR						
Pregnant women (15-45yrs) registered for ANC	-0.218	0.000	-0.197	0.001	-0.178	0.005
Mothers who received more than 3 ANC	-0.172	0.004	-0.133	0.025		
Mothers who received at least one TT inj. In ANC	-0.154	0.009	-0.128	0.031		
Mothers who underwent USG	-0.347	0.000	-0.299	0.000	-0.326	0.000
Mothers who received PNC within 48hrs of delivery	-0.179	0.002	-0.155	0.009	-0.158	0.014
Mothers who received PNC within 1 week of delivery	-0.177	0.003	-0.156	0.008		
Institutional delivery	-0.253	0.000	-0.220	0.000	-0.172	0.008
Safe delivery	-0.251	0.000	-0.219	0.000	-0.135	0.036
Delivery at home by skilled birth personals	-0.224	0.000	-0.186	0.002	-0.224	0.000
Abortion in institute	-0.172	0.004	-0.170	0.004		
Positively correlated with MMR						
Delivery at home	0.238	0.000	0.205	0.000	0.151	0.019
Staying < 24 hrs at institute where delivery was conducted	0.238	0.000	0.230	0.000		

* Total areas i.e. in a state; § Rural areas of a state; Urban areas of a state

(B) Bivariate analysis

The results of bi-variate analysis for MMR and various components of maternal health care services were shown in Table 1 along with correlation coefficient (R value) and P value. (**Table 1)**. Variables which were significantly associated with MMR were only shown in the table. The health service components those were significantly and negatively correlated with MMR helped to reduce MMR. On the contrary where percentages of home delivery and staying < 24hrs at institute were high, there MMR was also high as these were significantly and positively correlated with MMR.

There was a considerable correlation between USG in ante natal period and MMR(R= -0.347, P= 0.000). Relation between USG in ante natal period and MMR was significant in both rural and urban areas. Institutional delivery was found to be significantly and negatively correlated with MMR(R= -0.253, P= 0.000).

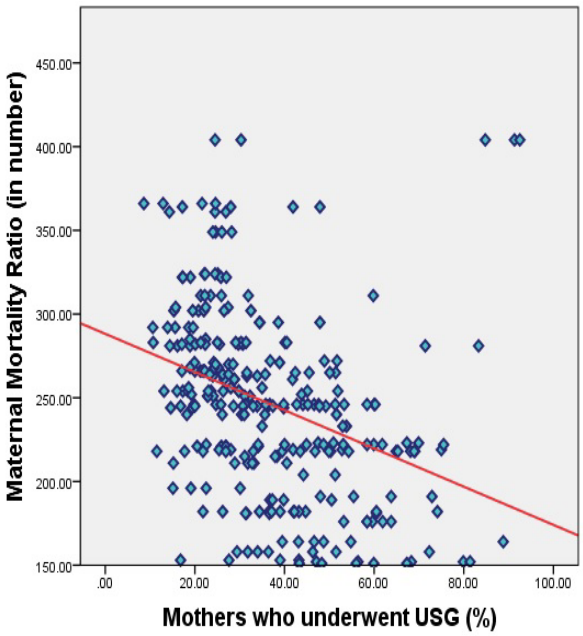

Fig 2: Scatter plot showing relationship between MMR and USG in antenatal period.

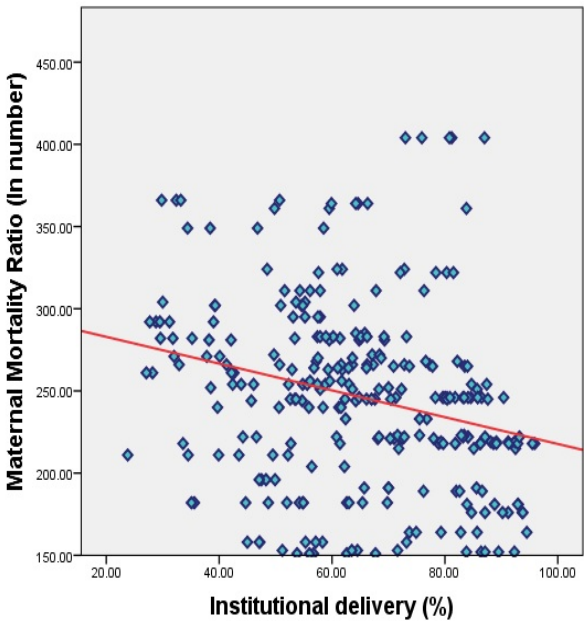

Fig 3: Scatter plot showing relationship between MMR and Institutional delivery

There scatter plots shown in the fig 2 & 3. Safe delivery had also a significant and negative correlation with MMR. Like ANC post natal care also protective for maternal health as it had a significant and negative correlation with MMR. Delivery at home and staying < 24 hrs at institute where delivery was conducted were positively correlated with MMR and these were significant. That means areas where home delivery was more, MMR was also high in that areas. But home delivery by skilled birth personnel was found to be negatively associated with MMR. Similarly < 24 hrs stays at institute after delivery had a negative impact on maternal health. Scatter plot of these two were shown in figure 4. **(Figure 2, 3 and 4)**

(C) Regression analysis

We built a regression model to explore the association between MMR and components of health services. Table 2 shows the results of regression analysis for MMR and other components of health care services.After controlling for important confounding factors in binary logistic regression, health service components like ≥ 3 ANC during pregnancy, USG in ANC, institutional delivery and JSY scheme to mothers were found to be significantly associated with MMR. However we were unable to find significant association between Post natal care and MMR in the study. Registration for ANC in pregnancy was not significantly associated with MMR. Conversely having ANC for more than 3 times during pregnancy was significantly associated with MMR. But this was not seen in urban areas. USG during pregnancy was found to have significant impact on MMR both in rural and urban areas. Higher Institutional delivery rate and higher JSY scheme utilization significantly associated with lower MMR. However these associations were not significant in urban areas. JSY scheme had the highest Odd ratio [1.037 with CI (0.009-1.072)] for MMR among all variables. **(Table 2)**

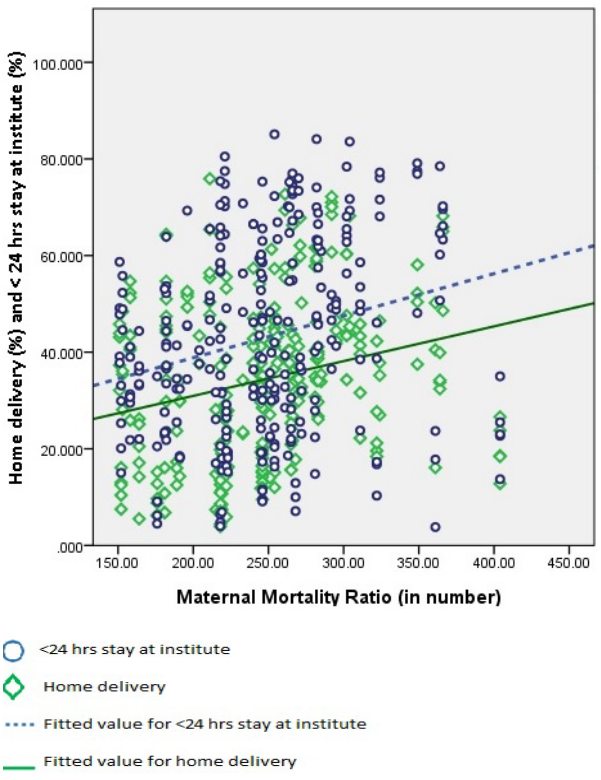

Fig 4: Scatter plot showing relationship between MMR and Home delivery, < 24 hrs stay at Institute

Table 2: Binary logistic regression assessing correlation between MMR and components of maternal health care services (AHS 2012-13 reports)

Variables	MMR@		Total		Rural		Urban	
	≤246	>246	Odd Ratio(CI)	p value	Odd Ratio(CI)	p value	Odd Ratio(CI)	p value
Effective literacy rate#	67.02	62.65	0.98 (0.94-1.02)	0.321	0.98 (0.94-1.02)	0.283	1.02 (0.96-1.09)	0.479
Mean age at marriage#	21.12	21.00	1.7 (1.16-2.5)	0.007	1.72 (1.19-2.48)	0.004	1.48 (1.02-2.14)	0.039
Mothers who received ≥3 ANC	61.84	48.16	0.98 (0.95-1)	0.017	0.97 (0.95-0.99)	0.009	1 (0.97-1.02)	0.825
Mothers who register for ANC	73.93	66.02	0.98 (0.96-1.01)	0.176	0.98 (0.96-1)	0.095	1 (0.98-1.03)	0.817
Mothers who underwent USG in ANC	43.24	28.94	0.97 (0.94-0.99)	0.006	0.97 (0.94-0.99)	0.01	0.95 (0.93-0.98)	0
Institutional delivery	70.85	57.75	0.96 (0.92-1)	0.047	0.95 (0.91-1)	0.041	0.98 (0.94-1.02)	0.237
Received PNC within 48hrs of delivery	77.55	69.46	0.99 (0.96-1.02)	0.598	0.99 (0.97-1.02)	0.575	0.98 (0.94-1.03)	0.459
JSY scheme beneficiary	54.75	45.73	1.04 (1-1.07)	0.047	1.04 (1-1.09)	0.04	1 (0.98-1.03)	0.857

#Mean of variables in two groups; @group based on mean MMR;*statistically significant

DISCUSSION

Our analysis showed that none of the nine states included in the study attained the target MMR planned in MDG.[5] Mean MMR of all the nine states were far away from the target. Among the states Assam had the highest MMR (292). Pregnant women (15-45yrs) registered for ANC, mothers who received more than 3 ANC, mothers who received at least one TT inj. in ANC, mothers who underwent USG during antenatal period, mothers who received PNC within 48hrs of delivery and within 1 week of delivery, institutional delivery, safe delivery, delivery at home by skilled birth personals and abortion in institute were significantly and negatively associated with MMR in bivariate analysis. Similarly delivery at home and staying < 24 hrs at institute where the delivery was conducted were significantly and positively correlated with MMR in bivariate analysis. But in regression analysis, it was found that there was a significant association between MMR and Mothers receiving ≥ 3 ANC during pregnancy, USG in ANC, institutional delivery and availing financial assistance from JSY scheme. Our study indicated that higher proportion of ≥ 3 ANC during pregnancy significantly associated with lower MMR. That means areas where more proportion of mother received ≥ 3 antenatal Cares during pregnancy there MMR was low. Because ANC during pregnancy gives opportunity to find out risk pregnancy and hence better care and precaution can be given in pregnancy and during delivery. This facilitates early detection of pregnancy related complications during pregnancy and delivery which in turn likely to decrease the Maternal mortality. This relation between ANC and MMR was significant in rural areas but not in urban areas. Our study found that simply registration for ANC during pregnancy was not significantly associated with MMR. This is because registration alone doesn't confirm regular ante natal visits during pregnancy. Similar observation consistent with that of a systematic review conducted by Berhan et al. Study showed that increase proportion of ANC cause fall in maternal mortality ratio.[9] Mohammed et al. also found a significant relationship between level of utilization of ANC services with prevention of maternal mortality among women in Bauchi state, Nigeria.[10] Fowole et al. reported that risk of maternal death decreased with increased number of Antenatal visits in mothers in Nigeria and death among women with no antenatal care was about two and half times higher than in women who had at least one ANC.[11]

This study demonstrated a significant association between institutional delivery and MMR in rural areas. In the study Institutional delivery had an inverse effect on MMR. Mothers delivering at home likely to suffer more from birth complication than those deliver at home as they get a skilled person and emergency obstetric care in the institute. This was also found by Berhan et al. in their study.[9] But the results of study by Randive et al were contradictory to our findings. In their study they were unable to detect a significant association between institutional delivery and MMR.[12]

In our study it was found that JSY scheme for mothers helped in reduction of MMR. Its effect seen more in rural areas, but there was no significant association of JSY scheme and MMR in Urban areas. This scheme primarily aims to provide cash incentives to mothers who give birth in a health institute, So that it can reduce maternal mortality by promoting institutional delivery. But Randive et al did not find a significant association between JSY scheme and MMR in their study. They took data from AHS 2010-11 reports like in our study, however they considered only JSY scheme health component. So the results obtained may be due to presence of other confounders.[12] Similar insignificant association between MMR and JSY scheme was also found by Ng et al and lim et al in their studies.[13, 14]

In our study there was a significant association between USG in antenatal period and MMR. USG in antenatal period offers a great opportunity to detect risk or complication of pregnancy and hence likely to reduce MMR. The association was significant in both rural and urban areas but highly significant in urban areas. Harris et al also found ultrasound system helped to reduce maternal mortality in low resource setting.[15] Post partum check up

soon after delivery within 48 hrs is crucial for the health of mothers. So, Post natal care within 48 hrs of delivery was significantly and negatively correlated with MMR in bi-variate analysis. But we were unable to find a significant association between them in logistic regression analysis. This lack of association could be explained by that in AHS it was presumed that whoever stayed at institute after delivery for 48 hrs had post natal check up. But mothers staying at hospital may not get proper post natal check up or good quality of services. It was also possible that mothers who didn't stay at institute after delivery may have post natal check up at somewhere else. In this study Mean age of marriage showed a significant association with reduction in MMR.

Limitation

In AHS MMR was calculated for 3 to 5 conterminous districts and in our study these values were ascribed to individual districts during analysis. So MMR values were based on community level surveys. In our study the associations between MMR and other service components can be confounded by known and unknown confounders. These may be quality of service provided, emergency transport services in districts, cultural practices among people, availability of maternal health services and awareness of people about these services. This study was unable to manage the effect of these confounders as there were no definite data on these variables in this study. So, further studies are needed to look into these areas. We acknowledge there are confounding effects likely to be present in our study. However regardless of these limitations, the study explored the association between various health service components and MMR, so this study makes an important contribution.

CONCLUSION

Our study showed that there was a significant association between MMR and maternal health service components like Antenatal care during pregnancy, USG in antenatal period, Institutional delivery and JSY scheme to mothers. These components are independently associated with MMR in presence of other service components. It implies that these components have greater impact on MMR. Higher coverage of ante natal care in pregnancy, USG in ante natal period, institutional delivery and JSY scheme to mothers significantly reduce MMR to a greater extend. So these components of maternal services should get more focused attention to decline MMR rapidly. This does not mean that other maternal services have no role or less important for maternal health, but rather emphasizes that these components should get more focused attention to reduce MMR expendiously. By this we can achieve the SDG target that is to have MMR < 70 per 100,000 live births within stipulated time period.

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