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H. N. Ranganathan* and P. P. Rode**

On a Method of Estimating Level of Maternal Mortality in Rural India from Limited Data

Introduction

IN the National Health Policy of India it has been laid down that, amongst other things, the maternal mortality rate (MMR) should be brought down to less than 2 by the year 2000 (Year book of FWP in India 1990-91), and to achieve this goal, strategies have been planned under the 'Child Survival and Safe Motherhood Programme' (Govt. of India 1991, CSSM Programme). The action plan under this programme comprises immediate activities to be taken up which are health interventions and long-term activities which are concerned with socio-economic development of women, especially education, status and empowerment To keep track of the level and trend, no annual data on MMR are however available at present, the impression being that it might be about 4 per 1000 live births at present.

Generally, the Vital Registration System *(VRS)* of any country should be able to provide the necessary information on MMR. But the Indian *VRS* continues to suffer from quantitative and qualitative deficiencies even though statutory registration has been in operation in the whole country for more than 2 decades under the Registration of Births and Deaths Act, 1969.

The Vital Statistics Report of India for the year 1986 (RGI1991) shows that among 22 states which contribute most to the country's population, in only 4 states, viz., Maharashtra, Nagaland, Punjab and Tamilnadu, the completeness of birth registration is 75% or above. In 2 states only, viz., Maharashtra and Punjab, the level of death registration is of the order of 75% and the population of these two states form 11.7% of the country's population. Thus, gross ommissions are still observed in most parts of India in the vital registration records.

As regards qualitative aspect of registration, the situation is still worse. For instance, for about 15% only of the registered deaths in the country, the cause of death is medically certified (RGI 1987) and most of them are in respect of Institutional deaths taking place in cities and towns. If correction for under-registration of deaths is made, the coverage dips down further.

Several studies have been carried out in the past to ascertain the MMR. They are mostly ad hoc and hospital-based. However, 3 community-based ad hoc studies providing estimates of MMR for large populations such as state and district levels, carried out during the 1980's can be mentioned here. One relates to the whole of Rural Maharashtra (Chandrakapure and

* Deputy Director of Health Services i/c HI & VS (Retd), Govt. of Maharashtra.
** Statistical Officer. Office of the Deputy Director of Health Services, SBHI & VS, Govt of Maharashtra.

Ranganathan 1985) for which the *MMR* was estimated to be 3.33 in the year 1983. In the second study (Bhatia 1993) carried out in Amanthapur district of Andhra Pradesh, it was assessed as 7.98 for the year 1984-85. In the third study (Phatak and Ram 1993) the *MMR* was estimated for rural India and also some states (Rural) for each of the years 1985-1988. The level was found to be between 3 and 4 during 1985-1988 in Rural India according to this study.

A simple methodology is presented in this paper which can be profitably used to ascertain the *MMR* annually in India as well as various states for rural areas by utilising the limited data available at present. The methodology is explained and illustrated in subsequent sections.

Methodology

For a geographic area, let *r, b, d* and *p* denote the annual *MMR,* birth rate, death rate, and proportion of maternal deaths out of total deaths at all ages of both the sexes combined respectively. Maternal death includes death of a woman, the cause being linked to maternal causes during pregnancy, delivery and postpartum period, *r* is computed by

$$r = \frac{\text{Annual maternal deaths}}{\text{Annual live births}} \times k$$

It can be easily seen that the above expression is equal to

$$r = \frac{p\,d}{b}\,k. \qquad (1)$$

Where *k* is the multiplying factor which is taken as 1000,10,000 or 100,000 depending upon the practice of the country. In India, it is taken as 1000.

Data Source of Birth and Death Rates

A nationwide Sample Survey has been going on in India (RGI 1991) since the past 2 decades which provides annual estimates of *b* and *d* for the country as a whole as well as each state for rural and urban areas separately. This Sample Survey is widely known as 'Sample Registration System' *(SRS)* and is carried out under the aegis of the Registrar General, India. The *SRS* has the design of dual independent recording of births and deaths. In the randomly selected villages and urban blocks, part-time enumerators who normally reside in the selected villages and urban blocks, are appointed to keep track of the vital events as they occur and record them in survey schedules. A six-monthly independent survey is carried out in the same selected villages and urban blocks by a supervisor. The vital events observed from this dual recording procedure and matched. After verification, the un-duplicated vital events are obtained for calculating the vital rates. The *SRS* does not provide *MMR.* The annual estimates of *b* and *d* yielded by *SRS* are utilized here to estimate *MMR.* The number of Sample Villages selected for *SRS* has been varying over the years and at present it is about 4100 (RGI 1991).

Data Source for Proportion of Maternal Deaths

There is a data source on mortality causes known as 'Survey of Causes of Death (Rural)'. Like the *SRS*, the survey of causes of death (Abbreviated here as *SCDR)* is also nationwide and has been going on continuously since the past 2 decades under the aegis of the Registrar General, India. In the early years of starting this survey, it was called 'Model Registration Survey of Cause of Death'. The main objective *of SCDR* is to obtain cause-of-death statistics based on systematic enquiry made by field workers (Para health functionaries of Primary Health Centre) in the absence of data on medically certified causes of death. The Sample villages which are the headquarters of the Primary Health Centres *(PHC)* are randomly selected. The field workers are given training in the art of eliciting systematically information on the signs and symptoms and also the circumstances that led to death by immediately contacting the family of the deceased person. To facilitate collection of basic information correctly and completely, a printed manual of instructions (RGI1971) translated into regional languages is also provided to the field workers. The particulars of signs and symptoms of the disease are recorded in prescribed formats and are checked by the Medical Officer *(MO)* of the *PHC*. The *MO* also decides the most probable cause of death in the absence of any medical certificate of cause of death based on the particulars collected by the field workers. The data obtained from *SCDR* are familiarly known as 'Non-Medical List of Causes of Death *(N M* List)' to distinguish the data from medically certified causes of death and are annually published sepcravcly by the Registrar General, India. The *NM* List, is similar to 'Lay reporting of health information' published by the WHO (WHO 1978). Among the 10 major groups of causes, under *SCDR*, there is one related to maternal deaths.

The proportion of deaths due to maternal deaths *(p)* is computed and the same is utilized here. The total number of sample villages selected *for SCDR* has been varying over the years and at present it is about 1300 (RGI 1992).

Computation of Maternal Mortality Rate

By utilizing the *b* and *d* yielded by *SRS* and *p* yielded by *SCDR*, the *MMR* can be calculated from (1) given above. The estimated *MMR* for India (Rural) for each of the years 1981-1992 is given in Table 1 and its trend is also depicted in Chart 1. The *MMR* was observed to be 3.89 per 1000 live births in the year 1981 and came down slightly to 3.62 in the year 1992 with fluctuations in the intervening years. On the whole, the *MMR* seems to have followed a downward trend. The *MMR* available from other studies are also presented for comparative picture.

Maternal Mortality Rate in States

Following the same procedure, the *MMR* can be worked out for each state. In order to overcome the problem of small numbers of annual maternal deaths, the basic data have been pooled for the *quinquennia* 1981-1985 and 1986-1990 and the mean *MMR* has been computed.

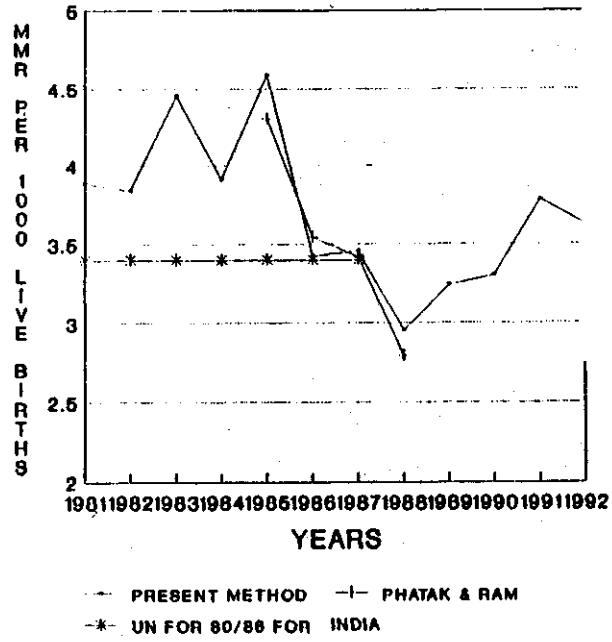

Chart 1. Maternal Mortality Rate in India (Rural)

Thus

$$r_{1981-1985} = \frac{\bar{p}\,\bar{d}\,k}{\bar{b}} \qquad (2)$$

Where $\bar{b}$ and $\bar{d}$ are the mean of the birth and death rates and $\bar{p}$ is the mean proportion of maternal deaths for 1981-1985 given by

$$\bar{p} = \frac{\text{Maternal deaths during 1981–1985}}{\text{Total deaths during 1981–1985}}$$

with similar computation for 1986-1990.

The estimated *MMR's* for 1981-1985 and 1986-1990 arc presented in Appendix, Table A-l and compared with those of other independent studies available for some years.

During 1981-1985 (Table A-1) the highest A/A//? was observed in Assam (7.89) and lowest in Punjab (1.78).

In 9 slates, the *MMR* was higher than All India Level (3.68) and in 7 states it was lower. During 1986-1990 also the highest *MMR* was seen in Assam (10.07) and the lowest in Punjab (0.90). In 6 states, it was higher and in 10 states it was lower than All India Level (3.30). The relative situation in 1981-1985 and 1986-1990 in each state is also presented in Chart 2.

TABLE 1 : MATERNAL MORTALITY RATE IN INDIA (RURAL). 1981-1992

Year	*Total reported deaths in SCDR*	*Reported maternal deaths in SCDR*	*P*	*b from S R S*	*d from S R S*	*r per 1000 live births*	*r from other studies*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1981	17394	175	0.0101	35.6	13.7	3.887	
1982	16143	168	0.0104	35.5	13.1	3.838	
1983	17210	206	0.0120	35.3	13.1	4.453	3.40*
1984	17680	176	0.0100	35.3	13.8	3.909	
1985	17238	208	0.0121	34.3	13.0	4.586	4.304**
1986	18262	176	0.0096	34.2	12.2	3.425	3.544**
1987	20241	197	0.0097	33.7	12.0	3.454	3.416**
1988	22950	182	0.0079	32.1	12.0	2.953	2.793**
1989	21409	202	0.0094	32.2	11.1	3.240	
1990	21028	210	0.0100	31.5	10.4	3.302	
1991	22629	251	0.0111	30.8*"	10.5***	3.784*"	
1992	26118	270	0.0103	30.7*"	10.8***	3.624*"	

Sources of Data : (1) SRS Reports and (2) Annual Reports on *SCDR*.

* U.N. Estimate for whole of India for 1980-1986.

** Study of Pathak and Ram.

*** Provisional.

Maternal Mortality by Age of Mother

In respect of one state—Maharashtra, it has been possible to ascertain the *MMR* by age of mother as the basic data were available in broad age groups for this state. The *MMR* by age of mother is given by

$$ri = \frac{\text{Maternal deaths in age } i}{\text{Live births mothers in age } i} \times K \qquad (3)$$

The *RHS* of (3) is equal to

$$ri = p \frac{d}{b} \frac{p_i^1}{pi} \times K \qquad (4)$$

and

$$r = \Sigma piri \qquad (5)$$

when pi and p_i^1 are proportions of live births to mothers in age i and maternal deaths in age i respectively. ri being the *MMR* in age i. For computation of ri, p_i^1 is obtained from *SCDR* of Maharashtra. As regards p_i, it is derived from the age distribution of live births by age of mothers given for a random sample of registered livebirths and records of *PHC*s. The basic data are published in the State Annual Reports. It is assumed that the age distribution of live births by age of mother based on vital registration and *PHC* records is not biased because

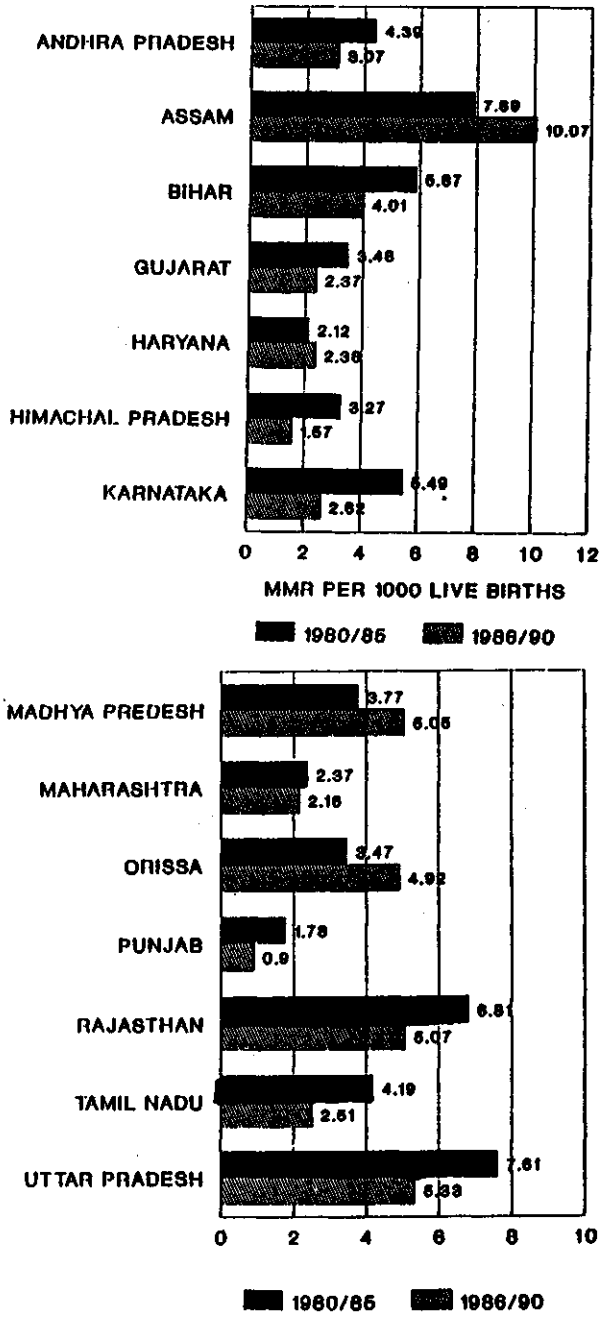

Chart 2. Maternal Mortality Rate in States of India (Rural), 1981/85 and 1986/90

of under-registration. For *quinquennia* 1980-1985 and 1986- 1990, the *MMR* by age of mother derived from (4) is given in Table 3 and also presented graphically (Chart 3).

There is practically no change in he *MMR* in age (15-24) and (25-34) of 1980-1985 and 1986-1990. However steep fall is observed in (35-44) in 1986-1990.

TABLE 2: STATES WHOSE MATERNAL MORTALITY RATES WERE HIGHER/LOWER THAN ALL INDIA LEVEL 1981-1985 AND 1986-1990

Period	*States with MMR higher than All India Level*	*States with MMR lower than All India Level*
1981-1985	(1) Andhra Pradesh (2) Assam (3) Bihar (4) Jammu & Kashmir (5) Karnataka (6) Madhya-Pradesh (7) Rajasihan (8) Tamil Nadu and (9) Utur Pradesh	(1) Gujarat (2) Haryana (3) Himachal Pradesh (4) Kerala (5) Maharasbtra (6) Orissa and (7) Punjab
1986-1990	(1) Assam (2) Bihar (3) Madhya Pradesh (4) Orissa (5) Rajasihan and (6) Uttara Pradesh	(1) Andhra Pradesh (2) Gujarat (3) Haryana (4) Himachal Pradesh (5) Karnataka (6) Maharashtra (7) Punjab and (8) Tamil Nadu

Note : All India (Rural) Level of *MMR:* 3.676 in 1981-1985 and 3.298 in 1986-1990

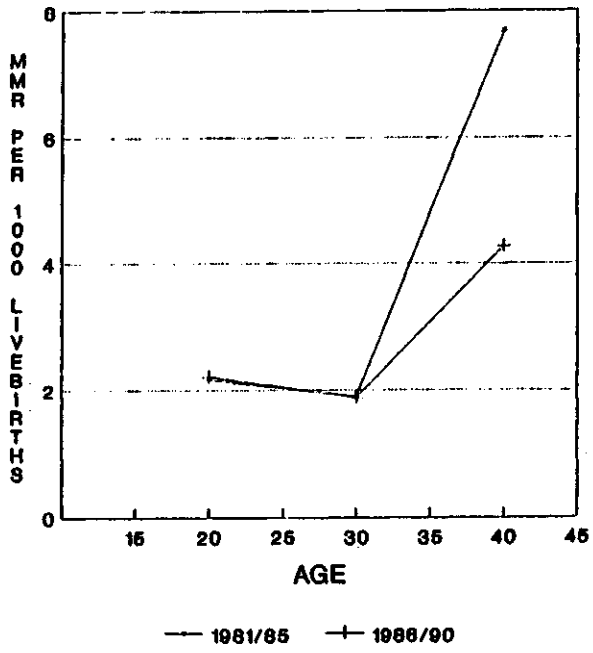

Chart 3. Maternal Mortality Rale by Age of Mother, Maharashtra (Rural), 1981/85 and 1986/90

TABLE 3 : MATERNAL MORTALITY RATE BY AGE OF MOTHER, MAHARASHTRA (RURAL), 1981-1985 AND 1986-1990

Age in year (i)	*Proportionate live births (pi)*		*Proportionate maternal deaths (pi^1)*		*MMR (ri)*	
	1981-85	*1986-90*	*1981-85*	*1986-90*	*1981-85*	*1986-90*
15-24	0.4859	0.5374	0.4445	0.5486	2.17	2.21
25-34	0.4549	0.4168	0.3636	0.3611	1.89	1.88
35-44	0.0592	0.0458	0.1919	0.0903	7.68	4.27
Total/Overall	1.0000	1.0000	1.0000	1.0000	2.37	2.16

Notes :
1. Number of Sample live births—86452 in 1981-85 and 366466 in 1986-1990.
2. Number of maternal deaths—100 in 1981-85 and 144 in 1986-90.
3. Proportionate maternal deaths *(P)* — 0.0072 in 1981-85 and 0.0071 in 1986-1990.
4. Birth rate : 31.00 in 1981-85 and 30.58 in 1986-1990.
5. Death rate : 10.20 in 1981-85 and 9.32 in 1986-1990.
6. Source for (1) above : Annual III & VS Reports for 1981 to 1990 of the Directorate of Health Services, Government of Maharashtra.
7. Source for birth and death rates: SRS Reports.

Discussion

The present methodology demonstrates that the level of *MMR* in India can be ascertained by utilising the readily available data yielded by 2 large scale and nationwide sample surveys viz. (1) *SRS* and (2) *SCDR* that have been going on continuously so far and will continue in future also. The *MMR* ascertained from the methodology compares well with those of independent studies not only at the national level but also at subnational levels and this close agreement gives validity to data sources utilized in the methodology. The methodology has many advantages. In the first place, *MMR* can be ascertained annually. Second, the *MMR* can be known not only at the national level but also at the state level. Third, no funds are necessary for estimating the *MMR* as the methodology makes use of the available data. Thus a very important gap of knowledge is filled in *MCI I* care of the community.

Special mention needs to be made here about the *SCDR* because of its potential as a source of uscable data on mortality causes. There are at present over 20,000 *PHCs* (CBHI 1992) functioning in the country. The staffing pattern and other infrastructural facilities are the same in every *PHC*. Therefore, there should be no difficulty in covering the headquarter villages of all these 20,000 *PHCs* under the SCDR. It is learnt that in one of the states—Maharashtra, the coverage of more villages has been taken up in a phased manner. If this is done in all other states, valuable data base on mortality causes badly needed for the rural areas can be developed for utilisation in community health care programmes. As in all surveys, reliability of primary data in *SCDR* also, in terms of quality and quantity needs to be ensured by periodical training, close supervision of the field work and monitoring activities. Here again, the stale of Maharashtra has developed some indicators in respect of *SCDR* and also monitored under the Health Management Information System of the Directorate of Health Services. Further, the field workers who are para health personnel of

PHC have already professional schooling which is very beneficial for *SCDR*. Their skill and capability in ascertaining correctly and completely the signs and symptoms of mortality causes, get enhanced by refresher courses that can be conducted at the Health and Family Welfare Training Centres which are established not only at the national level but also in every state. Thus, periodical refresher courses and close supervision of the field work contribute to improve and sustain the quality and quantity of the *SCDR*.

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TABLE A-1: MATERNAL MORTALITY RATE IN VARIOUS STATES OF INDIA (RURAL), 1981-85 AND 1986-90

State		*Reported total deaths in SCDR*		*Reported maternal deaths in SCDR*		*Proportionate maternal deaths (P)*		*Birth Rate (6)*		*Death Rate (d)*		*MM R (r)*		
		1981-85	*1986-90*	*1981-85*	*1986-90*	*1981-85*	*1986-90*	*1981-85*	*1986-90*	*1981-85*	*1986-90*	*1981-85*	*1986-90*	*1985-88**
	(I)	*(2a)*	*(2b)*	*(3a)*	*(3b)*	*(4a)*	*(4b)*	*(5a)*	*(5b)*	*(6a)*	*(6b)*	*(7a)*	(7ft)	(7c)
I	Andhra Pradesh	6074	7066	72	63	0.1119	0.0089	31.48	*21.96*	11.60	9.64	4.39	3.07	3.33
2	Assam	1322	1372	28	39	0.0212	0.0284	35.10	32.14	13.06	11.38	7.89	10.07	10.03
3	Bihar	7405	7527	114	85	0.0154	0.0113	38.64	§6.20	14.74	12.84	5.87	4.01	4.85
4	Gujarat	6010	9486	59	65	0.0098	0.0069	35.06	30.76	12.44	10.64	3.48	2.37	1.74
5	Haryana	1859	2575	14	23	0.0075	0.0089	37.80	35.20	10.66	9.38	2.12	2.38	1.48
6	Himachal Pradesh	1012	755	10	04	0.0099	0.0053	32.24	30.20	10.64	8.94	3.27	1.57	—
7	Jammu & Kashmir	710	—	15	—	0.0211	—	34.48	—	9.76	—	5.97	—	—
8	Kamataka	5203	4236	83	35	0.0160	0.0083	30.00	29.46	10.30	934	5.49	2.62	3.70
9	Kcrala	1445	—	12	—	0.0083	—	24.60	—	6.52	—	2.20	—	2.36
10	Madhya Pradesh	6736	7736	62	103	0.0092	0.0133	39.58	37.90	16.20	14.38	3.77	5.05	4.14
11	Maharashtra	13856	20225	100	144	0.0072	0.0071	31.00	30.58	10.20	9.32	2.37	2.16	2.01
12	Orissa	3855	4788	32	57	0.0083	0.0119	33.08	31.50	13.84	13.00	3.47	4.92	2.76
13	Punjab	6183	5792	34	17	0.0055	0.0030	30.42	28.78	9.84	8.66	1.78	0.90	1.46
14	Rajaslhan	3451	6851	65	101	0.0188	0.0147	40.20	35.42	14.56	12.18	6.81	5.07	5.96
15	Tamil Nadu	7550	7335	71	42	0.0094	0.0057	28.30	23.58	12.62	10.32	4.19	2.51	2.68
16	Ultar Pradesh	11469	12188	177	171	0.0154	0.0147	39.82	38.10	17.36	14.48	7.61	5.33	4.59

Information for other states in not available.

* This is from the study of Pathak and Ram. The *MMR* for each of the year 1985-1988 is published. Their mean value was taken and presented here in column 7c.

Source of Data : SRS for Birth and Death rates, and *SCDR* for total deaths and maternal deaths.