

Inter-District Variation in Child Mortality in Madhya Pradesh

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Abstract

With the publication of district level estimates of child (under five) mortality for 1981 and 1991 it has become possible to analyse the spatial variation in the level of and the decline in child mortality within the states. Madhya Pradesh records the second highest child mortality rate among the states of India. Inter-district variation is also quite large. The child mortality has been declining, but as indicated by ratios of female to male child mortality rate and regression analysis the female children are less benefited than the male children. A number of socio-economic factors exert influence on the level of child mortality. Of the twelve factors examined in this study, literacy was found to be of paramount importance.

Introduction

Child mortality has declined all over India since Independence, but the performance of different states and the different areas within the states has been highly variable. Madhya Pradesh has been a laggard, recording the second highest child mortality rate (CMR) after Orissa among the states and the Union Territories of India. Within the state itself, there is found a large inter-district variation in the levels and rates of decline in child mortality.

The present paper is an attempt to (i) explain inter-district variation in child (under-five) mortality levels in 1991 and changes that occurred in them during 1981-91, (ii) bring out gender differential in child mortality, and (iii) examine the influences of some socio-economic factors on child mortality in Madhya Pradesh¹.

Data

The study is based on the district level estimates of child mortality brought out by the Census of India (RGI, 1988) for 1981 and by Rajan and Mohanachandran (1998) for 1991. The estimates were made on the basis of some of the information contained in the censuses of the respective years. Since these are indirect estimates, no claim can be made for their being totally free from discrepancies, inconsistencies and inaccuracies. A second source of data at the state level is the National Family Health Survey. The NFHS data are based on sample surveys. The wide differences revealed by Table 1 between the state level child mortality data of these two sources confirms the doubt about their accuracy. However, in the absence of more reliable alternative, the analysis has been based on these indirect

1. Madhya Pradesh in this study means undivided Madhya Pradesh as it existed before the formation of the new state of Chhattisgarh on November 1, 2000.

Table 1 India : Child Mortality Rates

State	Child Mortality Rate	
	Census Estimate (1991)	NFHS (1993)
Andhra Pradesh	68	127
Assam	117	164
Bihar	89	154
Gujarat	85	123
Haryana	72	121
Himachal Pradesh	97	102
Karnataka	81	123
Kerala	46	45
Madhya Pradesh	159	163
Maharashtra	72	98
Orissa	160	172
Punjab	66	84
Rajasthan	109	118
Tamil Nadu	69	114
Uttar Pradesh	120	183
West Bengal	88	128
India	96	137

Sources: Column 2 : Rajan and Mohanachandran (1998)
Column 3 : Bhat and Zavier (1999)

estimates. As regards socio-economic correlates, data were obtained from relevant state government records.

Child Mortality : Level and Decline

In 1991 Madhya Pradesh recorded CMR of 159 which was much above the national average of 96. Within the state, CMRs varied from 97 in Indore district to 239 in Shivpuri district with coefficient of variation of 20.45 per cent (Fig.1). It shows that CMRs were highly variable and at the same time very

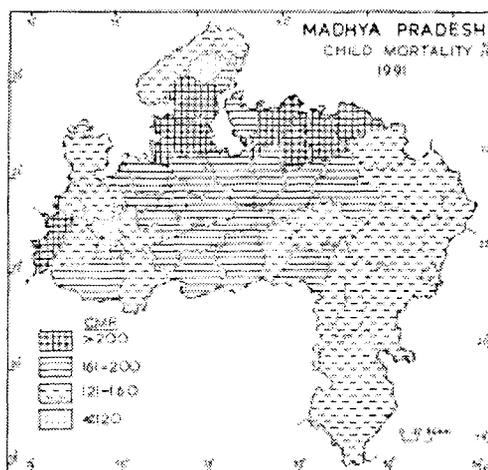


Fig. 1

high, surpassing the national average in all the districts of the state.

Out of 45 districts of the state, twenty one had CMRs less than the state average. These districts lie in four blocks. Ten districts of eastern Madhya Pradesh including all the seven districts of Chhattisgrah with extensions in Sidhi in the north, and Mandla and Seoni in the west form the largest block. The second block includes seven districts of the west extending from Mandsaur in the north through Ratlam, Ujjain, Dhar, Indore and Dewas to Khandwa (East Nimar) in the south. The third block is constituted by three districts, viz. Gwalior, Morena and Bhind in the north. The fourth block comprises only one district, Bhopal.

The rest 24 districts recorded higher CMRs than the state average. Some of these districts had CMRs even in excess of 200. They are Rewa, Satna, Panna and Chhatarpur districts of Vindhya Pradesh, and Shivpuri and Guna districts of Madhya Pradesh.

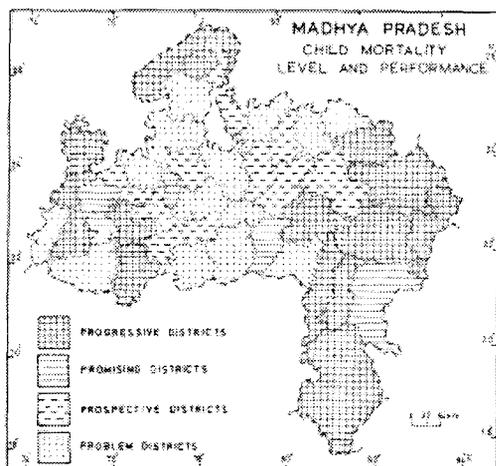


Fig. 2

The CMR of the state declined during 1981-91 from 197 to 159. But there was a large variation in the spatial pattern of change. While CMRs declined in 43 districts ranging from 2 per cent in Sivpuri to 43.5 per cent in Gwalior, two tribal districts, namely Jhabua and Betul recorded increase to the tune of 14.4 per cent and 3.4 per cent in their respective CMRs. To see if the amount of change in CMRs during 1981-91 was associated with CMRs of the districts in 1981, co-efficient of correlation was worked out between these two variables. The resultant $r = +.197$ indicates positive but insignificant relationship.

Treating the state average figures as the dividing lines, the districts of the state may be classified into the following four categories on the basis of CMRs of the districts in 1991 and per cent change therein during 1981-91

1. **Progressive districts:** These districts numbering 16 are characterised by faster decline in CMRs during 1981-91 and lower CMRs in 1991 as compared to the

state as a whole. They are Durg, Bastar, Surguja, Raigarh, Bilaspur, Rajnandgaon, Mandla, Sidhi, Dhar, Dewas, Mandsaur, Ratlam, Khandwa (East Nimar), Gwalior, Morena, and Bhind. It may be noted that in 1981, Rajnandgaon, Sidhi, Khandwa, Bhind, and Morena had CMRs above the state average, but due to faster decline in their CMRs they improved their position.

2. **Promising districts:** Five districts, namely Indore, Ujjain, Bhopal, Raipur and Seoni had lower CMRs in 1991 in spite of slower decline in their CMRs during 1981-91. They fall in this category. Chhindwara, Balaghat, Khargone (West Nimar) and Jhabua also had lower CMRs than the state average in 1981, but because of very slow decline in their CMRs or even increase in case of Jhabua, they lost their place in this category.

3. **Prospective districts:** Ten districts characterised by higher CMRs in 1991 but faster decline in their CMRs during 1981-91 are included in this category. They are Jabalpur, Shahdol, Hoshangabad, Sehore, Shajapur, Vidhisha, Damoh, Datia, Panna, and Tikamgarh.

4. **Problem districts:** Fourteen districts which had not only higher child mortality level in 1991 but also recorded either increase or slower decrease in CMRs during 1981-91 have been termed as problem districts. They are Khargone (West Nimar), Jhabua, Balaghat, Chhindwara, Narsighpur, Betul, Sagar, Rewa, Satna, Chhatapur, Guna, Rajgarh, Raisen and Shivpuri.

Gender Differentials in Child Mortality

Bias in favour of male children in India and many other countries is well known and well recorded (Arnold et.al, 1998; Agnihotri, 2001). Due to this attitude female children receive less health care, which leads to their higher mortality in spite of their being biologically stronger (UN, 1997, 62). Both in 1981 and 1991, female child mortality exceeded male child mortality. During 1981-91, while male CMR declined from 193 to 152, i.e. by 21.2 per cent, female CMR declined from 201 to 166 i.e. only by 17.4 per cent. It shows that male child mortality declined at a faster rate than female child mortality.

Ratios of female to male CMRs and regression equations between these two variables were computed to bring out the magnitude of gender bias in child mortality. Ratio in excess of 100 per cent indicate increasing female disadvantage. The female CMR declined in 42 districts, remained constant in one, namely shivpuri, and increased in two, i.e. Jhabua and Betul districts where CMRs of both sexes increased during 1981-91. Although decline in female CMR was recorded in 42 districts in absolute term, the ratio of female to male CMR declined only in fourteen districts. The ratio for the state also increased from 104.1 in 1981 to 109.2 per cent in 1991. This clearly shows an unfavourable trend for female children vis-a-vis male children.

Regression equations ($Y=a+b_x$) for male and female CMRs of all the 45 districts of the state for 1981 and 1991 work out as under:

1981 : $CMR_f = - 30.7474 + 1.2164 CMR_m$

1991 : $CMR_f = + 11.8989 + 1.0479 CMR_m$

Where CMR_f is female child mortality rate, and CMR_m male child mortality rate.

The constant term 'a' shows female child mortality rate at the zero level of male child mortality. The coefficient (slope) 'b' indicates the rate at which the female child mortality will decline in relation to male child mortality decline. The coefficient being more than one indicates faster decline of female mortality than male mortality. In 1981, the female child mortality exceeded quite substantially male child mortality at higher level. The gap narrowed with declining mortality and both the rates (CMR_m and CMR_f) converged at about 142. Below this level the gap started widening again but this time CMR_m overtaking CMR_f . In 1991 also, the gap between male and female child mortality narrowed slowly with declining mortality but there was an excess of female mortality even at the zero level of male mortality.

A comparison between figs 3A and 3B reveals that during 1981-91 the gap between male and female child mortality widened. It became still wider at lower level of mortality. The trend shows an increasing neglect of female children.

In spite of the majority of the districts showing a neglect of female children, fifteen districts (Including twelve eastern and three western districts) recorded lower female mortality than male mortality in 1981. But in 1991, the number of such districts decreased to 12 because eight districts lost their status and five new districts upgraded to join them.

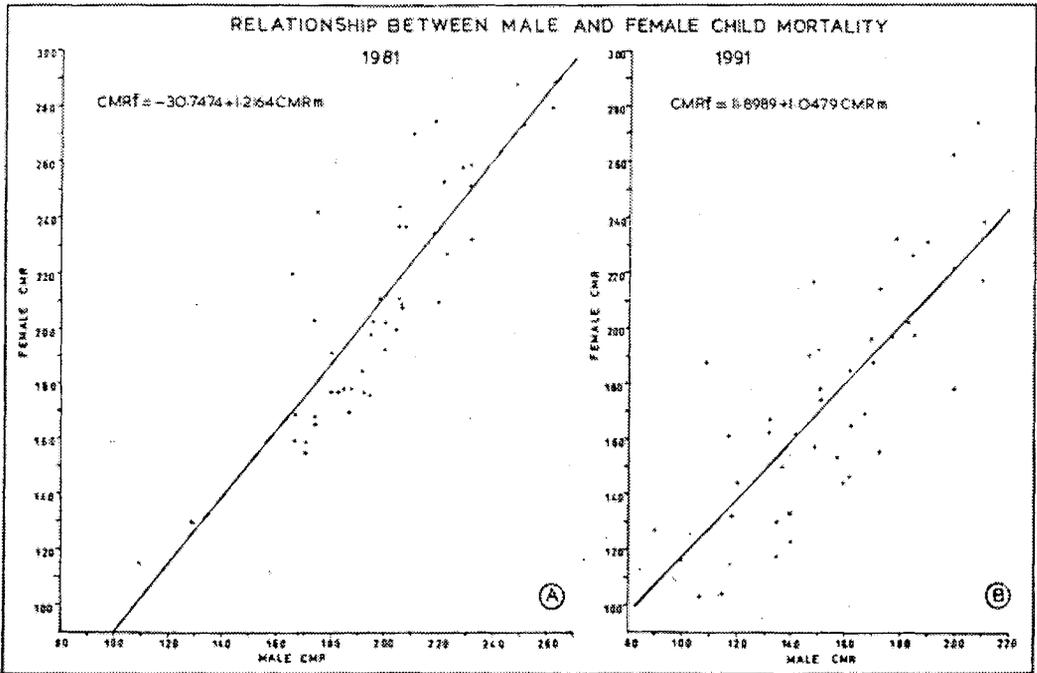


Fig. 3A

Fig. 3B

Table 2 Co-efficients of Co-relation between Variables (Independent and Dependent)

Variable	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	Y
	MMR	TFR	TBA	HB	AH	PHC	FLR	MLR	RIU	NAW	TC	NP	CMR
X ₁ MMR	1.000	+ .5078	-.7903	-.3796	-.0954	-.0131	-.5195	-.4847	-.5870	-.5846	-.6665	-.3457	+ .6729
X ₂ TFR		1.000	+ .4012	-.1335	-.1031	-.1566	-.4072	-.4251	-.3913	-.2936	-.3533	-.1295	+ .4959
X ₃ TBA			1.000	+ .3617	+ .1628	+ .1296	+ .3685	+ .2345	+ .4950	+ .5348	+ .6058	+ .1872	-.5578
X ₄ HB				1.000	+ .3195	+ .0908	+ .2584	+ .1490	+ .2964	+ .3940	+ .4995	+ .4070	-.2836
X ₅ AH					1.000	+ .7292	-.2245	-.4012	-.0977	-.1917	-.0903	+ .1598	.2895
X ₆ PHC						1.000	-.2034	-.4539	-.1194	-.2420	-.1739	+ .1278	-.3018
X ₇ FLR							1.000	+ .8774	+ .6975	+ .7827	+ .6978	+ .0362	-.3822
X ₈ MLR								1.000	+ .6471	+ .6456	+ .5661	+ .0875	-.3622
X ₉ RIU									1.000	+ .7079	+ .8123	+ .4595	-.5250
X ₁₀ NAW										1.000	+ .9188	+ .1146	-.3979
X ₁₁ TC											1.000	+ .3663	-.4496
X ₁₂ NP												1.000	-.3063
Y CMR													1.000

$r = .2836$, significant at .05 level of confidence

$r = .3622$, significant at .01 level of confidence

Socio-Economic Correlates of Child Mortality

A number of conceptual frameworks have been put forward for the analysis of proximate and socio-economic determinants of infant and child mortality (Mosley and Chen, 1984; Jain, 1985; Mahadevan, 1986; Jain and Visaria, 1988; Ren, 1996; Achyut et al. 1997; D'Souza and Bryant, 1999). Drawing on these and depending upon the availability of district level published data, influences of the following twelve factors on child mortality were analysed in the present study:

A. Demographic factors	X1	Maternal mortality rate (MMR)
	X2	Total fertility rate (TFR)
B. Health	X3	Per cent of births attended services by trained persons (TBA)
	X4	No. of hospital beds per 1 lakh population (HB)
	X5	No. of allopathic hospitals per 1 lakh population (AH)
	X6	No. of PHCs and sub PHCs per 1 lakh population (PHC)
C. Education	X7	Female literacy rate (FLR)
	X8	Male literacy rate (MLR)
D. Economic	X9	No. of registered industrial development units per 1 lakh population (RIU)
	X10	Per cent of non-agricultural and non-household industrial workers (NAW)

E. Communication	X11	No. of telephone connections per 1 lakh population (TC)
	X12	No. of newspapers per 1 thousand households (NP)

All these factors are significantly correlated with child mortality (Table 2). As expected MMR and TFR have positive correction, while other factors have negative correlation with CMR, showing thereby that each of them have played some role in determining the level of child mortality in the districts of Madhya Pradesh. However, these factors do not influence child mortality independently and in isolation. Rather most of them are interrelated and work jointly. To find out their combined effect and relative importance in determining CMR, multivariate analysis was attempted.

The Multiple Regression Equation works out as under:

$$R^2 = 0.6658$$

$$Y (\text{CMR}) = 299.897 + 0.083X_1 + 1.4674X_2 - 0.101X_3 - 0.115X_4 - 3.1225X_5 - 4.0438X_6 + 2.3522X_7 - 2.2944X_8 - 1.0234X_9 - 0.9216X_{10} + 0.0121 X_{11} + 0.5756 X_{12}$$

R² value shows that about 67 per cent variation in CMR is accounted for by variations in these independent variables. The coefficients indicate weights of different independent variables. But since the units of measurements of different variables are not the same, the coefficients do not indicate their relative importance. The relative importance can be found out by converting the values into standard scores and thus standardising the data (Yeates, 1974, 120-122).

On the basis of the standard scores of the values, the regression equation works out as under:

$$Y \text{ (CMR)} : 0.000 + 0.4172 X_1 + 0.0267 X_2 - 0.0439 X_3 - 0.0349 X_4 - 0.0944 X_5 - 0.4858 X_6 + 0.6912 X_7 - 0.7210 X_8 - 0.3329 X_9 - 0.3604 X_{10} + 0.2921 X_{11} + 0.0661 X_{12}$$

The relative importance revealed by these coefficients is not indicated by simple bi-variate co-relation co-efficients. The standardised regression co-efficients (stb) and coefficients of correlation between different variables may be used to estimate direct, net, indirect and joint (pair) effects of independent variables on child mortality (Pathak and Singh, 1994, 116-117). The Standardised regression coefficients (stb) indicate relative direct effects of respective independent variables. The square of stb shows net effect. Treating correlation co-

efficient between an independent variable (X_i) and child mortality (Y) as total effect of that factor, its indirect effect may be found out by subtracting stbi from $r_{x_{iy}}$.

Thus indirect effect of independent variable of

$$X_i = r_{x_{iy}} - \text{stb}_i$$

Joint(pair) effect of X_i and X_j independent variables will be $2 \text{ stb}_i \cdot \text{stb}_j \cdot r_{x_{ixj}}$

Table 3 reveals that male literacy, number of PHCs and sub PHCs, maternal mortality rate, percentage of non-agricultural and non-household industrial workers, and number of registered industrial units exerted substantial direct effects on child mortality as expected. Most of the other factors had mainly indirect effects. It may be noted that female literacy had a very high indirect negative effect, while its direct effect was positive. Male literacy had a high negative

Table 3 Effects of Independent Variables on CMR

Dependent Variables	Independent Variables	Direct Effect	Net Effect	Indirect Effect
C	X1 MMR	+ 0.4172	0.1741	+ 0.2557
	X2 TFR	+ 0.0267	0.0007	+ 0.4692
	X3 TBA	- 0.0439	0.0019	- 0.5139
	X4 HB	- 0.0349	0.0012	- 0.2487
	X5 AH	- 0.0944	0.0089	- 0.1951
M	X6 PHC	- 0.4858	0.2360	+ 0.1840
	X7 FLR	+ 0.6912	0.4778	- 1.0734
R	X8 MLR	- 0.7210	0.5198	+ 0.3588
	X9 RIU	- 0.3329	0.1108	- 0.1921
	X10 NAW	- 0.3604	0.1299	- 0.0375
	X11 TC	+ 0.2921	0.0853	- 0.7417
	X12 NP	+ 0.0661	0.0044	- 0.3724

Table 4 Joint (Pair) Effect of Independent Variables on CMR

Variable	X ₁ TFR	X ₂ TBA	X ₃ HB	X ₄ AH	X ₅ PHC	X ₆ FLR	X ₇ MLR	X ₈ RIU	X ₉ NAW	X ₁₀ TC	X ₁₁ NP
X ₁ MMR	+ 0.0113	+ 0.0289	+ 0.0111	+ 0.0075	+ 0.0053	- 0.2996	+ 0.2916	+ 0.1631	+ 0.1758	- 0.1624	- 0.0191
X ₂ TFR		+ 0.0009	+ 0.0002	+ 0.0005	+ 0.0041	- 0.0150	+ 0.0164	+ 0.0069	+ 0.0057	- 0.0055	- 0.0005
X ₃ TBA			+ 0.0011	+ 0.0013	+ 0.0055	- 0.0224	+ 0.0148	+ 0.0145	+ 0.0169	- 0.0156	- 0.0011
X ₄ HB				+ 0.0021	+ 0.0031	- 0.0125	+ 0.0075	+ 0.0069	+ 0.0099	- 0.0102	- 0.0019
X ₅ AH					+ 0.0069	+ 0.0293	- 0.0546	- 0.0061	- 0.0130	0.0050	- 0.0020
X ₆ PHC						+ 0.1366	- 0.3180	- 0.0386	- 0.0847	+ 0.0494	- 0.0082
X ₇ FLR							- 0.8745	- 0.3210	- 0.3900	+ 0.2818	+ 0.0033
X ₈ MLR								+ 0.3106	+ 0.3355	- 0.2384	- 0.0083
X ₉ RIU									+ 0.1699	- 0.1580	- 0.0202
X ₁₀ NAW										- 0.1934	- 0.0055
X ₁₁ TC											+ 0.0141

direct effect, but indirectly it affected child mortality positively. As regards communication factors, their negative effects were rather indirect. Total fertility rate had positive effect, but it was mainly indirect rather than direct.

As regards joint (pair) effect male and female literacy (MLR+FLR) jointly played very significant role in containing child mortality. This pair of factors followed in importance in this respect by FLR + NAW, MLR + NAW, FLR + RIU, MLR + PHC, MLR + RIU, FLR + MMR, MLR+MMR, FLR+ TC and MLR + TC (Table 4). The result underlines the importance of literacy. Other factors assume importance in association with literacy.

Conclusion

The level of child mortality in Madhya Pradesh is very high, so much so that even the district with the lowest child mortality rate, i.e. Indore surpassed the national average in 1991. The inter-district variation in child mortality is also quite large.

In spite of a general decline in child mortality two tribal districts recorded an increase, and female children were less benefited than the male children from this trend during 1981-91. The situation is distressing particularly in fourteen districts identified as problem districts where a slow decline or even a rise is associated with very high levels of child mortality. However, the situation is slightly better in Chhattisgarh (the seven eastern districts) and some other districts with respect to the level of and decline in and between gender differential in child mortality.

Child mortality level is determined by a number of factors. Twelve such factors were examined and all were found to have played some role. As expected, two demographic factors, viz. maternal mortality and fertility have positive relationship, while others related with health services, education, economic development and communication have negative correlation with child mortality.

Multivariate analysis reveals that out of the twelve factors, only five, viz (i) male literacy, (ii) number of primary and sub-primary health centres, (iii) maternal mortality, (iv) percentage of non-agricultural and non-household industrial workers and (v) number of registered industrial units exerted substantial direct effects as expected, the rest seven had mainly indirect effects on child mortality. It is noteworthy that female literacy, contrary to expectation had a positive direct effect. However, its indirect effect was negative and quite large. As regards joint (pair) effect, male and female literacy played a very significant role in containing child mortality. Other factors assumed importance mainly in association with male or female literacy.

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