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Education of Women and Reproductive and Child Health in Madhya Pradesh: District Level Analysis

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Abstract

In this paper we explore how inter-district variation in women education explains inter-district variation in selected reproductive and child health indicators in Madhya Pradesh. We find that inter-district variation in women education explain only a small proportion of inter-district variation some of the reproductive and child health indicators. This means that reducing inter-district variation in women education may have only a limiting role in reducing inter-district variation in reproductive and child health situation in the state. Reduction in inter-district variation in women education may be more effective in reducing inter-district variation in reproductive and child health situation in the state when reduction in inter-district variation in women education is associated with reduction in inter-district variation in the availability of and access to core reproductive and child health services.

Background

Many studies have shown the benefits that education of women has on the health of women and health of their children. These studies link women education with reduced child and maternal deaths, improved child health and nutrition, and lower fertility. Women with at least some formal education have been found to be more likely than uneducated women to practice family planning for regulating their fertility, either spacing or limiting births, and marry later. Educated women are also better informed on their nutritional and other health needs and nutrition and other health needs of their children. The total fertility rate in women with 10-12 years of schooling in India was 1.88 children per woman of reproductive age compared to the total fertility rate of 2.82 children per women of reproductive age in women with no education during 2019-2021 (Government of India, 2022). The total wanted fertility rate in India is found to be lower in women with at least 10 years of schooling compared to women with less than 10 years of schooling (Government of India, 2022). In Mali, women with secondary or higher education have been found to have an average of 3 children while those with no education have an average of 7 children (UNESCO, 2010a). In Uganda, women with additional schooling have been found to be more likely to have used contraception before first pregnancy and to delay marriage (Keats, 2018). Similarly, a study in Guatemala has found that for each additional year a young woman spent in school, the age at which she had her first child was delayed by approximately six to 10

months (Behrman et al, 2006). The median age at first marriage in women aged 25-49 years with at least 10 years of schooling in India is found to be more than 19 years compared to less than 19 years in women of this age group with less than 10 years of schooling (Government of India, 2022).

There is also evidence to suggest that improvement in the education of women is directly related to improved utilization of maternal health care services. In Burkina Faso, mothers with secondary education have been found to be twice as likely to give birth more safely in a health facility as compared to women with no education (UNESCO, 2010a). A study has estimated that an additional year of schooling for 1,000 women helps prevent two maternal deaths (Summars, 1992). Another study, in Uganda has, observed that to improve professional maternal health care utilisation, there is need to focus on education women beyond the primary level (Amwonya et al, 2022).

Increasing women education has positive effects on infant and child survival and health. Data from the National Family Health Survey, 2019-2021 suggest that the risk of death in the first five years of life in India is found to be less than 35 deaths for every 1000 live births in children whose mothers have at least 10 years of schooling compared to more than 40 deaths for every 1000 live births in children whose mothers have less than 10 years of schooling (Government of India, 2022). It is estimated that a child born to a mother who is able to read is 50 per cent more likely to survive past the age of 5 years as compared to a child born to an illiterate woman (UNESCO, 2010b). In Indonesia, child vaccination rates are 19 per cent when mothers have no education. This figure increases to 68 percent when mothers have at least secondary school education (UNESCO, 2010b). In Bangladesh and Indonesia, the odds of having a child who is shorter than average for its age is found to decrease by around 5 per cent for every additional year of formal education a mother has (Semba et al, 2008). In India, the prevalence of stunting in children below 5 years of age is found to decrease with the increase in number of years of schooling of the mother. These and many other studies suggest that there is a strong association between the variation in the educational status of women of reproductive age and the variation in the reproductive and child health status of the population. It can, therefore, be hypothesized that populations with high level of women education have comparatively better reproductive and child health status as compared to populations with low level of women education.

In this paper, we analyse the above hypothesis in Madhya Pradesh, India through the analysis of inter-district variation in women education and inter-district variation in reproductive and child health situation. We explore how inter-district variation in the educational status of women of reproductive age influences inter-district variation in selected indicators of reproductive and child health. We expect a direct relationship between the educational status of women of reproductive age in the district with the reproductive and child health status in the district as reflected through inter-district variation in a selected set of reproductive and child health indicators. If this relationship is true, then we argue that investing in the education of women of reproductive age must be an integral component of the efforts and interventions directed towards improving reproductive and child health status of the population of the state. Exploring the linkages between inter-district variation in women education and inter-district variation in reproductive and child health is particularly relevant to Madhya Pradesh as both level of

women education and reproductive and child health situation vary widely across the districts of the state and reducing this inter-district variation can go a long way towards improving the reproductive and child health situation of the state.

The paper is based on the data available through the fifth and the latest round of the National Family Health Survey, 2019-2021 in Madhya Pradesh (Government of India, 2021). The National Family Health Survey is a nationally representative sample survey that provides estimates of selected indicators including indicators related to the educational status of women of reproductive and indicators related to reproductive and child health status for each of the 707 districts of the country as they existed at the time of the survey. These include 51 districts of Madhya Pradesh as they existed at the time of the survey. The number of districts in Madhya Pradesh has now increased to 55. Data related to the newly created districts are, however, not available. In each district, assessment of women education and reproductive and child health status is based on the information collected from a statistically representative sample of households.

We have measured the education status of women of reproductive age in a district in terms of the proportion of women of reproductive age (15-49 years) who had at least 10 years of schooling at the time of the survey. On the other hand, the following indicators have been used to reflect the reproductive and child health situation in the district:

1. Proportion of women aged 20-24 years who were married before reaching 18 years of age.
2. Proportion of institutional deliveries.
3. Proportion of births registered.
4. Proportion of 3rd and higher order births.
5. Prevalence of modern family planning methods.
6. Prevalence of female sterilization.
7. Proportion of children under 5 years of age stunted.
8. Proportion of children under 5years of age wasted.
9. Proportion of children under 5 years of age under-weight.
10. Proportion of women with low BMI.

Inter-district Variation in Women Education and Reproductive and Child Health in Madhya Pradesh

The appendix table presents estimates of the 11 indicators used in the present analysis for the 51 districts of Madhya Pradesh as estimated from the data available through the National Family Health Survey, 2019-2021. Summary measures of the inter-district distribution of the 11 indicators are presented in table 1 which shows that all the 11 indicators vary across the districts of the state and the inter-district distribution of different indicators is different. There is no district in which all the 11 indicators are the lowest among the 51 districts. Similarly, there is no district in which all the 11 indicators are the highest among the 51 districts. The rank of all districts is different in different indicators. This shows that the inter-district variability in both women education and reproductive and child health is quite complex in the state.

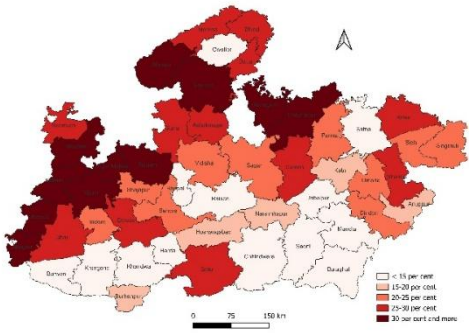
The educational status of women, as measured by the proportion of women with at least 10 years of schooling is found to be the lowest in district Sheopur where less than 16 per cent of the proportion of women were having at least 10 years of schooling at the time of the survey whereas this proportion is the highest in district Indore in which close to 50 per cent of the women were having at least 10 years of schooling at the time of the survey. In addition to district Indore, there are only two districts – Bhopal and Chhindwara – in which more than 40 per cent women were having at least 10 years of schooling at the time of the National Family Health Survey, 2019-2021. By contrast, there are 8 districts in the state in which the proportion of women with at least 10 years of schooling was less than 20 per cent in 2019-2021. In 17 districts of the state, however, this proportion was at least 30 per cent. The median proportion of women with at least 10 years of schooling across the 51 districts of the state is 27.7 per cent with and inter-quartile range of more than 7.

The proportion of women aged 20-24 years who reported that they had got married before reaching 18 years of age ranges between just around 4.4 per cent in district Balaghat to around 46 per cent in district Rajgarh of the state. The median proportion of women aged 20-24 years who reported to have got married before reaching 18 years of age across the 51 districts is found to be 23 per cent with an inter-quartile range of 13.6. In India, the legal minimum age at marriage of females is 18 years. This shows that marriage of females earlier than the legal minimum age at marriage of females is quite common in the state.

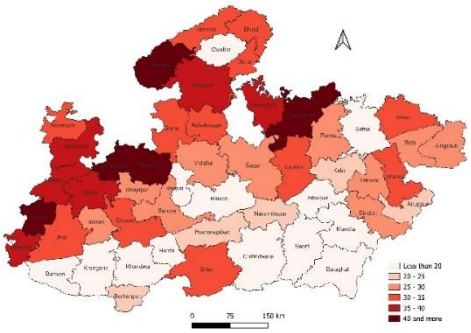
The proportion of women who reported that they had at least four ante-natal care visits at the time of their last pregnancy is found to vary from just around 30 per cent in district Panna to more than 76 per cent in district Dhar of the state. The median proportion of women who reported at the time of the survey that they had at least four ante-natal care visits during their last pregnancy is around 60 per cent with an inter-quartile range of almost 12. There are 10 districts in the state in which less than 50 per cent women reported that they had at least four ante-natal care visits during their last pregnancy.

The proportion of women who reported that their last delivery was an institutional delivery is found to vary from almost 100 per cent in district Mandsaur to less than 70 per cent in district Singrauli of the state at the time of the National Family Health Survey, 2019-2021. The median proportion of women who reported that their last delivery was an institutional delivery across the 51 districts is almost 92 per cent with an inter-quartile range of 8.6 while the range is almost 30. The narrow inter-quartile range indicates that in almost half of the districts of the state, the proportion of women who reported that their last delivery was an institutional delivery varied within a narrow range of 86-95 per cent but in the remaining half of the districts, this proportion varied widely.

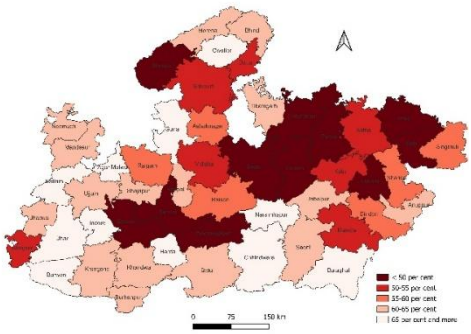
The proportion of women who reported that their last birth was registered with the competent authorities is found to vary from around 86 per cent in district Sheopur to 100 per cent in district Jabalpur. District Jabalpur is the only district in the state where all births reported at the time of the National Family Health Survey were found to be registered. The median proportion of births registered is almost 95 per cent and the inter-quartile range is less than 5 which means that in half of the districts of the state, the proportion of births registered varied within a narrow range of 92-97 per cent.



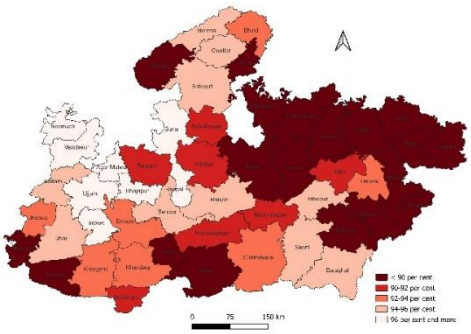
Proportion of women with at least 10 years schooling



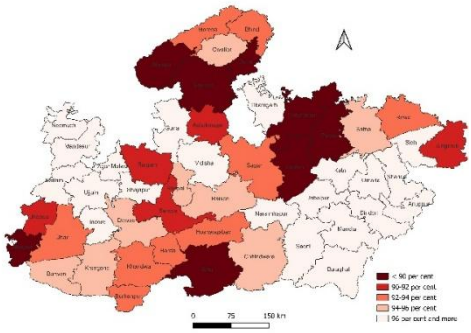
Proportion of women aged 20-24 years married before 18 years of age



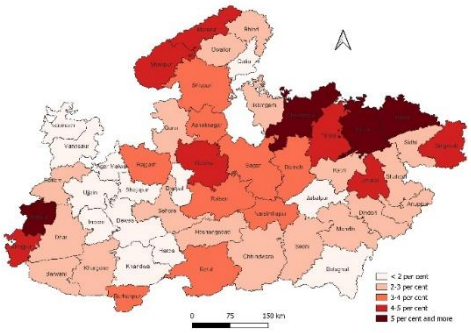
Proportion of women received at least 4 ANC during their last pregnancy



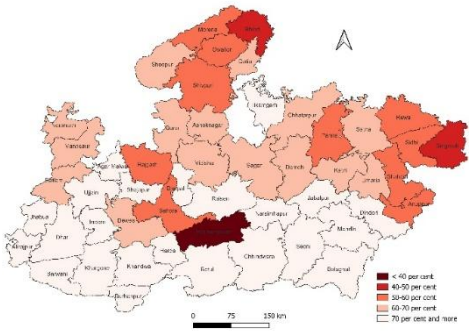
Proportion of women whose last delivery was an institutional delivery



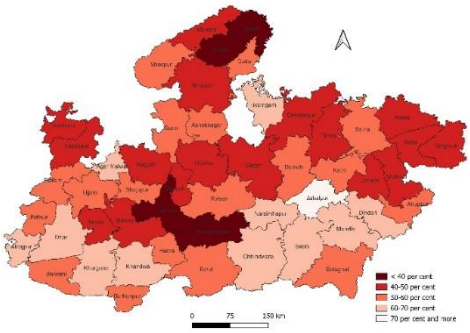
Proportion of women whose birth was registered



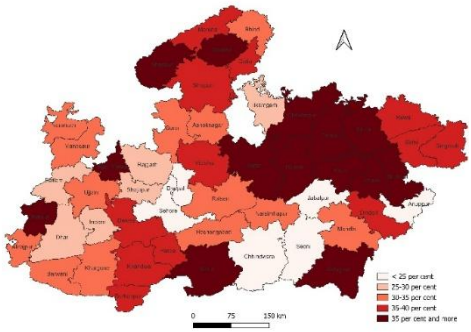
Proportion of women whose most recent birth was 3rd or hgher order birth



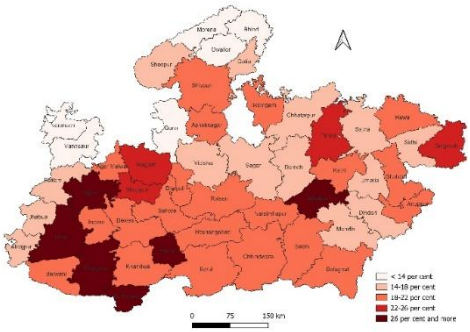
Proportion of women using a modern family planning method



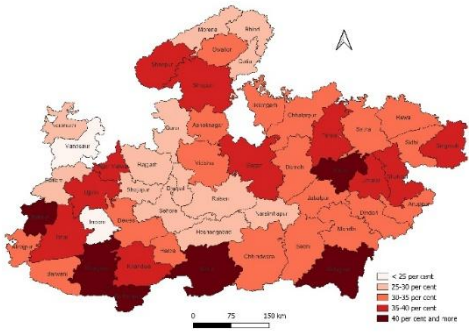
Proportion of women who were sterilised at the time of the survey



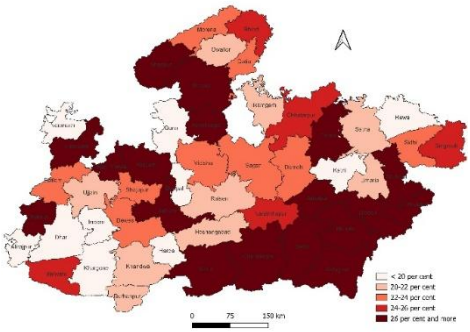
Proporiton of children below 5 years of age who were low height-for-age



Proportion of children below 5 years of age who were low weight for height



Proportion of children below 5 years of age who were low weight-for-age



Proportion of women with body mass index less than 18.5

Figure 1: Inter-district variation in women education and selected indicators of reproductive and child health in Madhya Pradesh, 2019-2021.
Source: Author, based on data from National Family Health Survey, 2019-2021.

Table 1: Summary measures of inter-district distribution of 11 indicators of women education and reproductive and child health in Madhya Pradesh, 2019-2021.

Indicators	Summary measures of distribution						
	Lowest	Q1	Median	Q2	Highest	IQR	Skewness
Women with at least 10 years of schooling (%)	15.9	23.8	27.7	31.1	47.7	7.3	0.703
Women aged 20-24 years married before 18 years of age (%)	4.4	15.9	23.0	29.5	46.0	13.6	0.071
Women received at least 4 ANC during their last pregnancy	30.9	52.8	60.4	64.7	76.5	11.9	-0.672
Women whose last birth was institutional birth (%)	69.9	86.3	91.8	94.8	99.4	8.6	-1.056
Women whose last birth is registered (%)	86.2	92.0	94.7	96.9	100.0	4.9	-0.651
Women whose last birth was third or higher order birth (%)	0.0	2.1	2.7	3.7	7.1	1.7	0.462
Women using a modern family planning method (%)	28.0	60.2	68.2	72.4	79.6	12.2	-1.417
Women who are sterilised	20.0	47.1	52.2	59.5	74.1	12.5	-0.635
Children below 5 years of age low height for age (%)	18.0	30.6	36.5	40.2	49.5	9.6	-0.153
Children below 5 years of age low weight for age (%)	10.1	16.2	18.9	21.2	29.8	5.0	0.386
Children below 5 years of age low weight for age	22.9	29.3	32.8	36.0	47.2	6.7	0.585
Women having body mass index (BMI) less than 18.5 (%)	15.6	21.0	23.1	26.8	30.5	5.8	-0.196

Source: Author

District Jabalpur is also the only district in the state where the proportion of 3rd and higher order births among the total number of births reported at the time of the National Family Health Survey, 2019-2021 was found to be zero. On the other hand, this proportion is found to be the highest in district Jhabua. The median proportion of 3rd and higher order births is 2.7 per cent with an inter-quartile range of 1.7. The proportion of third and higher order births in a district is directly related to the fertility in the district – the higher this proportion the higher the total fertility rate and vice versa.

The inter-district variation in the proportion of women using a modern family planning method varies widely across the districts of the state. In district Hoshangabad, only around 28 per cent women reported to be using a modern family planning method at the time of the survey whereas this proportion was almost 80 per cent in district Indore which means a range of 52. The median proportion of women using a modern family planning method is around 68 per cent with an inter-quartile range of more than 12. Hoshangabad is the only district in the state where less than 30 per cent of women reported to be using a modern family planning method at the time of the National Family Health Survey, 2019-2021.

The variation in the proportion of women sterilized at the time of the survey is found to be even wider that the variation in the proportion of women using a modern family planning method. In district Jabalpur, more than 74 per cent of women were reported to be sterilized at the time of the survey whereas this proportion was only 20 per cent in district Hoshangabad. The median proportion of women sterilized is 52 per cent and the inter-quartile range is more than 12 which confirms wide variation in the proportion of women sterilized across the districts of the state.

The proportion of women having low body mass index (BMI less than 18.5) is found to vary from the lowest in district Indore to the highest in district Sheopur. In district Indore, only around 15 per cent women were having low BMI at the time of the National Family Health Survey, 2019-2021 whereas this proportion was more than 30 per cent in district Sheopur. The median proportion of women having low BMI across the districts is almost 23 per cent with an inter-quartile range of less than 6. There are 10 districts in the state where this proportion was less than 20 per cent according to the National Family Health Survey, 2019-2021.

Table 1 also shows marked inter-district variation in the three indicators of child under nutrition – prevalence of stunting, prevalence of wasting and prevalence of underweight in children below 5 years of age. The proportion of children below five years of age who were low height-for-age (stunted) at the time of the National Family Health Survey, 2019-2021 varies from less than 23 per cent in district Mandsaur to almost 50 per cent in districts Jhabua and Katni. The median proportion of children below 5 years of age who were stunted at the time of the survey is 36.5 per cent while the inter-quartile range is almost 10. On the other hand, the proportion of children aged less than 5 years who were low weight-for-age (wasted) at the time of the survey ranged from just around 10 per cent in district Morena to almost 30 per cent in districts Ujjain and Dhar. There are seven districts in the state in which at least one fourth of the children below five years of age were found to be wasted at the time of the survey whereas district Morena is the only district where just around 10 per cent of the children aged below 5 years of age were wasted at the time of the survey. The median of the inter-district distribution of the proportion of children below five years of age who were wasted at the time of the survey is almost 19 per cent with an inter-quartile range of almost 5. Finaly, the proportion of children less than 5 years of age who were low weight-for-age (underweight) at the time of the survey ranged from almost 23 per cent in district Mandsaur to more than 47 per cent in district Burhanpur. There are six districts in the state – Balaghat, Barwani, Burhanpur, Jhabua, Katni and Khargone - in which the proportion of children below five years of age who were underweight at the time of the survey was more than 40 per cent whereas, in 15 districts this proportion was less than 30 per cent. Districts Barwani, Burhanpur, Jhabua and Khargone constitute a geographical continuity and are located in the south-west corner of the state. The median of the distribution of the proportion of children below five years of age who were underweight at the time of the National Family Health Survey 2019-2021 is estimated to be almost 33 per cent with an inter-quartile range of almost 7. This means that the proportion of children below five years of age who were underweight at the time of the survey ranged in a narrow range of 30-36 per cent but this proportion varied widely in the remaining 50 per cent districts of the state.

Inter-district Inequality in Women Education and Reproductive and Child Health

The inter-district variation in the indicators of women education and reproductive and child health may be summarized in terms of the coefficient of variation across districts which is defined as the ratio of the standard deviation to the arithmetic mean. The problem with the use of the coefficient of variation as a summary measure of the inter-district variation across districts or the index of inter-district inequality is that it is difficult to interpret the coefficient of variation when the inter-district distribution is not statistically normally distributed. The statistical normality of the distribution means that the sum of the deviation from the arithmetic mean must be equal to 0. When the inter-district distribution of an indicator is skewed, the use of the coefficient of variation as the summary index of inter-district variation or the index of inter-district inequality in the indicator is flawed.

In view of the limitations of the coefficient of variation as the summary index of variation across districts or the index of inter-district inequality when the inter-district distribution is not statistically normal but skewed, we have measured the index of inter-district inequality in terms of the index of inter-district variation which is defined as the positive square root the mean square deviation from the median of the distribution. In m denotes the median of the distribution, then the index of variation is defined as

$$IV = \sqrt{\frac{\sum_{i=1}^{n}\left(1-\frac{x_i}{m}\right)^2}{n}}$$

where n is the number of districts. It may be noticed that when the inter-district variation is distributed statistically normally, median is the same as the arithmetic mean and, therefore, the index of variation is the same as the coefficient of variation. The index of inter-district inequality for an indicator is zero when the value of the indicator is the same for all districts or when there is no variation in the indicator across the districts, and the higher the value of the index the higher the inequality across districts. Like the coefficient of variation, the index of variation is also dimensionless quantity and, therefore, it can be used for comparison across different variables of different dimensions.

The index of inter-district inequality in the proportion of women having at least 10 years of schooling in Madhya Pradesh is found to be 0.257 which is quite substantial, and which confirms that there is a substantial degree of disparity or the inequality in the educational status of women across the districts of the state. This inter-district inequality in women education may be a factor in the inter-district inequality in reproductive and child health in the state because of the association of reproductive and child health with women education.

Summary measures of the inter-district distribution of the selected reproductive and child health indicators in Madhya Pradesh are given in table 1, along with the index of inter-district inequality in different indicators. The inter-district inequality in the proportion of 3rd and higher order births is found to be the highest among the 11 indicators of reproductive and child health. The inter-district inequality has also been found to be very high in the proportion of women aged 20-24 years who were married before reaching 18

years of age - the legal minimum age at marriage for females in India. On the other hand, inter-district inequality is found to be the lowest in the proportion of births registered followed by the proportion of institutional births. Out of the 11 reproductive and child health indicators, the inter-districts inequality in 8 indicators is lower than that in the proportion of women having at least 10 years of schooling.

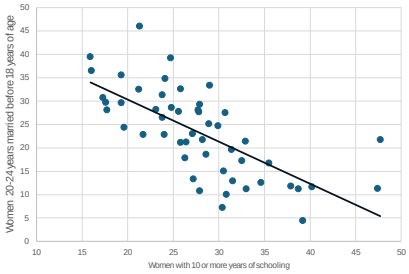
Relationship between Women Education and Reproductive and Child Health

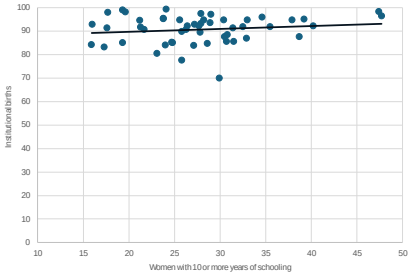
The bivariate relationship between inter-district variation in the proportion of women with at least 10 years of schooling and inter-district variation in 10 indicators of reproductive and child health is depicted in figure 2. The figure suggests that the relationship of the inter-district variation in the proportion of women with at least 10 years of schooling with inter-district variation in different indicators of reproductive and child health is different. The inter-district variation in some indicators does not appear to be associated with inter-district variation in the proportion of women with at least 10 years of schooling. Figure 2 implies that reducing inter-district variation in women education may not lead to reduction in inter-district variation in some reproductive and child health indicators.

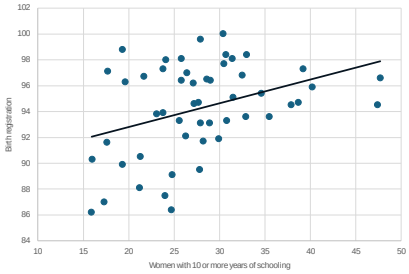
To further examine the relationship between the inter-district variation in women education and inter-district variation in selected reproductive and child health indicators in the state, we have applied the general linear model with the set of 10 reproductive and child health indicators as dependent variables and a set of independent variables including the proportion of women having at least 10 years of schooling. The general linear model is a compact way of simultaneously writing several multiple linear regression models. Different multiple linear regression models may be compactly written as (Mardia et al, 1979)

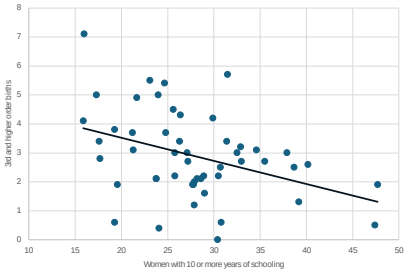
$$Y = XB + U$$

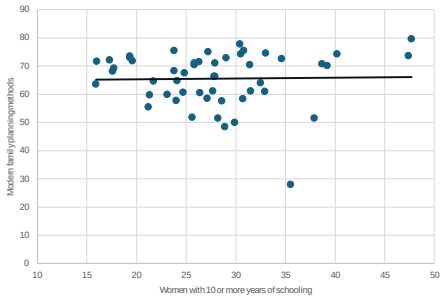
where Y is a matrix with series of multivariate measurements specific to different dependent variables. Each column of the matrix Y is a set of measurements on one of the dependent variables. Similarly, X is a matrix of measurements specific to different independent variables. Each column of X is a set of observations on one of the independent variables while B is a matrix containing parameters that are to be estimated and U is a matrix containing errors. It is assumed that errors are uncorrelated across measurements, and follow a multivariate normal distribution. The general linear model is a generalization of multiple linear regression to the case when there is more than one dependent variable. Hypothesis testing with the general linear model can be made in terms of the multivariate test or in terms of several independent univariate tests. In the multivariate test, the columns of Y or the dependent variables are tested for their association with the set of independent variables simultaneously. In case of univariate tests, each column of Y or each dependent variable is tested independently for its association with the set of the independent variables. When Y is a single column matrix, the general linear model reduces to the multiple linear regression model. When both Y and X are single column matrices, general linear model reduces to simple linear regression.

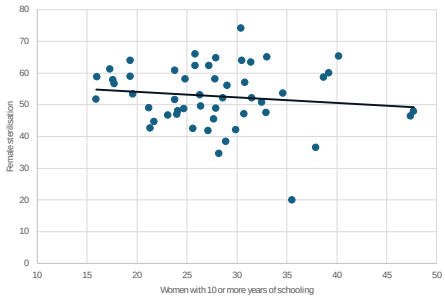

Women 20-24 years married before 18 years of age
Women with 10 or more years of schooling

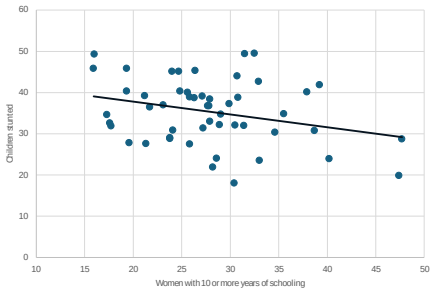

Institutional births
Women with 10 or more years of schooling

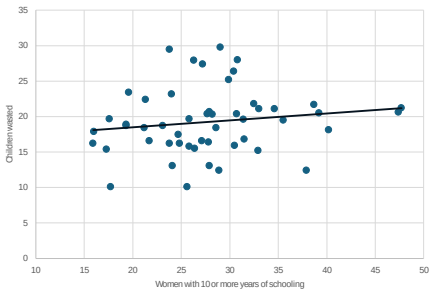

Birth registration
Women with 10 or more years of schooling


3rd and higher order births
Women with 10 or more years of schooling


Modern family planning methods
Women with 10 or more years of schooling


Female sterilisation
Women with 10 or more years of schooling


Children stunted
Women with 10 or more years of schooling


Children wasted
Women with 10 or more years of schooling

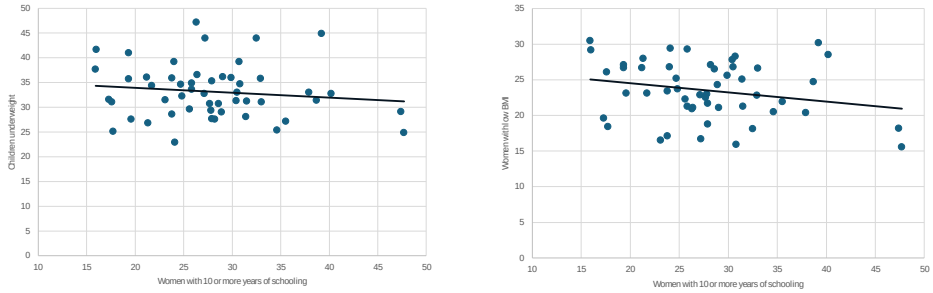


Figure 2: Inter-district variation in the proportion of women with at least 10 years of education and inter-district variation in selected indicators of reproductive and child health in Madhya Pradesh, 2019-2021.
Source: Author

In the present case, Y is a matrix comprising of 51 rows (districts) and 10 columns representing inter-district variation in 10 reproductive and child health indicators while X is a matrix comprising of 51 rows (districts) and 4 columns of independent variables - proportion of women having at least 10 years of schooling, proportion of urban households, reflecting the degree of urbanization in the district, proportion of Muslim households, reflecting the religious composition of the population of the district, and proportion of Scheduled Tribes households, reflecting the social class composition of the population in the district – representing inter-district variation in four independent variables. The last three independent variables are included in the model as control variables. It is assumed that different reproductive and child health indicators in a district may be influenced by the degree of urbanization in the district, and the religious and social class composition of the population of the district.

Results of the application of the general linear model are presented in tables 2 for the multivariate test and in table 3 for univariate tests. The multivariate test confirms that inter-district variation in the set of 10 reproductive and child health indicators in the state are statistically significantly associated with the inter-district variation in the four independent variables which means that inter-district variation in reproductive child health is associated with the inter-district variation not only in women education but also in the inter-district variation in degree or the extent of urbanization, the religious composition of the population and social class composition of the population in the district . Among the four independent variables, the most dominant effect is of the proportion of women with at least 10 years of schooling as may be seen from the value of the F statistic while the effect of the proportion of Scheduled Tribes households in the district is relatively the lowest. The multivariate test thus confirms that the inter-district variation in the reproductive and child health situation in the state, as reflected through the set of 10 reproductive and child health indicators is statistically significantly associated with the inter-district variation in the proportion of women with at least 10 years of schooling, inter-district variation in the degree or the level of urbanization in the district, the religious composition of district population and the distribution of the population of the district by social class. composition of the population of the district. Table 2 also suggests that inter-district variation in the

level of urbanization, measured in terms of the proportion of urban households, religious composition of the population measured in terms of the proportion of Muslim population and social class distribution of the population. The inter-district variation in women education appears to be an important predictor of inter-district variation in the 10 indicators of reproductive and child health in the state.

The multivariate test does not reveal how inter-district variation in women education is associated with inter-district variation in individual reproductive and child health indicators. The bivariate analysis suggests that this relationship is different for different reproductive and child health indicators. This relationship can be explored through the independent univariate test with each of the 10 reproductive and child health indicators as the dependent variable. The independent univariate test of the general linear model shows how inter-district variation in the proportion of women with at least 10 years of schooling is associated with inter-district variation in each of the 10 reproductive and child health indicators. The independent univariate tests provide statistical support to the bivariate relationship depicted in figure 2.

Table 2: Results of the general linear model – multivariate tests between reproductive and child health indicators and four independent variables.

Independent variables		Value	F	Hypothesis df	Error df	'p'
Proportion of women with at least 10 years of schooling	Pillai's Trace	0.763	11.889	10	37	.000
	Wilks' Lambda	0.237	11.889	10	37	.000
	Hotelling's Trace	3.213	11.889	10	37	.000
	Roy's Largest Root	3.213	11.889	10	37	.000
Proportion of urban households	Pillai's Trace	0.556	4.634	10	37	.000
	Wilks' Lambda	0.444	4.634	10	37	.000
	Hotelling's Trace	1.252	4.634	10	37	.000
	Roy's Largest Root	1.252	4.634	10	37	.000
Proportion of Muslim households	Pillai's Trace	0.586	5.244	10	37	.000
	Wilks' Lambda	0.414	5.244	10	37	.000
	Hotelling's Trace	1.417	5.244	10	37	.000
	Roy's Largest Root	1.417	5.244	10	37	.000
Proportion of Scheduled Tribes households	Pillai's Trace	0.395	2.414	10	37	.025
	Wilks' Lambda	0.605	2.414	10	37	.025
	Hotelling's Trace	0.652	2.414	10	37	.025
	Roy's Largest Root	0.652	2.414	10	37	.025
Intercept	Pillai's Trace	0.989	336.598	10	37	.000
	Wilks' Lambda	0.011	336.598	10	37	.000
	Hotelling's Trace	90.972	336.598	10	37	.000
	Roy's Largest Root	90.972	336.598	10	37	.000

Source: Author

Results of the independent univariate tests are presented in table 3. Inter-district variation in the proportion of women with at least 10 years of education is found to be statistically significantly associated with inter-district variation in the proportion of women aged 20-24 years who had got married before reaching 18 years of age, the legal minimum

age at marriage of females in India; registration of births; 3rd and higher order births; and proportion of children below five years of age who are stunted (low height-for-age) and the regression coefficients are in the expected direction. For example, the regression coefficient of the proportion of women aged 20-24 years who had got married before reaching 18 years of age on the proportion of women with at least 10 years of schooling is negative and statistically significant which means that the higher the proportion of women with at least 10 years of education in a district the lower the proportion of women aged 20-24 years who had got married before reaching 18 years of age in that district and vice versa. This means that women education has a strong impact on female age at marriage – the higher the level of women education the lower the proportion of women who are married at an age younger the legal minimum age at marriage and vice versa. The same is the case with the proportion of 3rd and higher order births and the proportion of children below five years of age who are stunted (low height-for-age) – the higher the proportion of women with at least 10 years of schooling in a district the lower the proportion of 3rd and higher order births and the proportion of children below five years of age who are stunted in that district and vice versa. The regression coefficient of the proportion of births registered on the proportion of women with at least 10 years of schooling is also positive which means that improving women education in the state may contribute significantly towards the realization of the goal of universal birth registration. However, the regression coefficient of the proportion of children below five years of age who are wasted (low weight-for-height) on the proportion of women with at least 10 years of schooling is found to be statistically significantly positive which means the higher the proportion of women with at least 10 years of education in a district the higher the proportion of children below five years of age who are wasted in the district and vice versa. The role of inter-district variation in women education in deciding inter-district variation in one dimension of child nutrition (stunting) and inter-district variation in other dimension of child nutrition (wasting) in the state is in opposite direction which makes the association of inter-district variation in women education with inter-district variation in child nutrition quite complicated and which needs to be explored further.

Table 3 also shows that the inter-district variation in the proportion of women with at least 10 years of schooling has not been found to be statistically significantly associated with inter-district variation in the proportion of institutional births, prevalence of modern methods of family planning, prevalence of female sterilization, proportion of children below 5 years age who are underweight (low weight-for-age) and proportion of women with poor nutritional status (BMI < 18.5). It appears that there are factors other than women education which are more dominant as regards inter-district variation in these indicators of reproductive and child health in the state.

Table 3 suggests that the association of inter-district variation in women education with inter-district variation in different components of reproductive and child health is not the same and inter-district variation in indicators related to some components of reproductive and child health does not appear to be associated with inter-district variation in the proportion of women aged 15-49 years with at least 10 years of schooling. This means that reducing inter-district variation in women education may contribute only marginally to reducing inter-district variation in these components of reproductive and child health in the state.

Table 3: Results of general linear model. Independent univariate tests of indicators of reproductive and child health on the proportion of women with at least 10 years of schooling.

Dependent Variable	Independent variable	B	Std. Error	t	'p'	95% Confidence Interval	
						Lower Bound	Upper Bound
Proportion of women aged 20-24 years married before 18 years of age	Proportion of women with at least 10 years of schooling	-1.297	0.148	-8.775	0.000	-1.594	-0.999
	Proportion of urban households	0.318	0.084	3.763	0.000	0.148	0.488
	Proportion of Muslim households	-0.478	0.190	-2.520	0.015	-0.859	-0.096
	Proportion of Scheduled Tribes households	-0.052	0.044	-1.182	0.243	-0.141	0.037
	Intercept	55.293	3.785	14.607	0.000	47.674	62.912
Proportion of institutional births	Proportion of women with at least 10 years of schooling	-0.011	0.141	-0.081	0.936	-0.295	0.272
	Proportion of urban households	0.067	0.080	0.835	0.408	-0.095	0.229
	Proportion of Muslim households	0.203	0.181	1.122	0.268	-0.161	0.566
	Proportion of Scheduled Tribes households	-0.075	0.042	-1.771	0.083	-0.159	0.010
	Intercept	90.188	3.607	25.000	0.000	82.927	97.450
Proportion of births registered	Proportion of women with at least 10 years of schooling	0.294	0.085	3.472	0.001	0.124	0.464
	Proportion of urban households	-0.099	0.048	-2.052	0.046	-0.197	-0.002
	Proportion of Muslim households	0.108	0.109	0.999	0.323	-0.110	0.327
	Proportion of Scheduled Tribes households	-0.013	0.025	-0.510	0.612	-0.064	0.038
	Intercept	88.224	2.168	40.691	0.000	83.860	92.588
Proportion of third and higher order births	Intercept	4.974	0.882	5.642	0.000	3.199	6.749
	Proportion of women with at least 10 years of schooling	-0.103	0.034	-2.992	0.004	-0.172	-0.034
	Proportion of urban households	0.029	0.020	1.467	0.149	-0.011	0.068

Dependent Variable	Independent variable	B	Std. Error	t	'p'	95% Confidence Interval	
						Lower Bound	Upper Bound
	Proportion of Muslim households	-0.062	0.044	-1.416	0.164	-0.151	0.026
	Proportion of Scheduled Tribes households	0.017	0.010	1.657	0.104	-0.004	0.038
Prevalence of modern family planning methods	Proportion of women with at least 10 years of schooling	0.144	0.232	0.619	0.539	-0.324	0.611
	Proportion of urban households	-0.054	0.133	-0.403	0.689	-0.321	0.214
	Proportion of Muslim households	0.593	0.298	1.989	0.053	-0.007	1.193
	Proportion of Scheduled Tribes households	0.152	0.069	2.184	0.034	0.012	0.291
	Intercept	56.274	5.952	9.454	0.000	44.293	68.256
Prevalence of female sterilisation	Proportion of women with at least 10 years of schooling	0.190	0.230	0.829	0.412	-0.272	0.652
	Proportion of urban households	-0.252	0.131	-1.921	0.061	-0.516	0.012
	Proportion of Muslim households	0.219	0.294	0.744	0.461	-0.374	0.812
	Proportion of Scheduled Tribes households	0.125	0.069	1.822	0.075	-0.013	0.263
	Intercept	49.453	5.881	8.410	0.000	37.616	61.290
Proportion of children below 5 years of age stunted	Proportion of women with at least 10 years of schooling	-0.412	0.192	-2.145	0.037	-0.799	-0.025
	Proportion of urban households	0.115	0.110	1.044	0.302	-0.107	0.336
	Proportion of Muslim households	-0.340	0.247	-1.378	0.175	-0.836	0.157
	Proportion of Scheduled Tribes households	0.043	0.057	0.749	0.458	-0.073	0.159
	Intercept	44.743	4.925	9.086	0.000	34.830	54.656
Proportion of children below 5 years of age wasted	Proportion of women with at least 10 years of schooling	0.245	0.109	2.238	0.030	0.025	0.465
	Proportion of urban households	-0.124	0.063	-1.982	0.053	-0.250	0.002

Dependent Variable	Independent variable	B	Std. Error	t	'p'	95% Confidence Interval	
						Lower Bound	Upper Bound
	Proportion of Muslim households	0.406	0.140	2.895	0.006	0.124	0.689
	Proportion of Scheduled Tribes households	0.028	0.033	0.860	0.394	-0.038	0.094
	Intercept	12.768	2.803	4.555	0.000	7.125	18.411
Proportion of children under 5 years of age under weight	Proportion of women with at least 10 years of schooling	0.051	0.125	0.408	0.685	-0.201	0.303
	Proportion of urban households	-0.096	0.071	-1.340	0.187	-0.240	0.048
	Proportion of Muslim households	0.397	0.160	2.473	0.017	0.074	0.720
	Proportion of Scheduled Tribes households	0.096	0.037	2.574	0.013	0.021	0.171
	Intercept	29.851	3.203	9.319	0.000	23.403	36.300
Proportion of women with low BMI	Proportion of women with at least 10 years of schooling	0.030	0.095	0.316	0.753	-0.161	0.221
	Proportion of urban households	-0.128	0.054	-2.364	0.022	-0.237	-0.019
	Proportion of Muslim households	-0.070	0.122	-0.574	0.568	-0.315	0.175
	Proportion of Scheduled Tribes households	-0.006	0.028	-0.217	0.829	-0.063	0.051
	Intercept	26.228	2.431	10.790	0.000	21.335	31.120

Source: Author

The inter-district variation in women education has not been found to be statistically significantly associated with inter-district variation in institutional births in the state. One possible reason is that inter-district variation in the proportional of institutional births is small and in majority of the districts, the proportion of institutional births to total births is more than 90 per cent irrespective of the proportion of women having at least 10 years of schooling. This may be due to monetary incentives provided to women for institutional deliveries to reduce maternal mortality and promote reproductive health (Government of India, *no date*). On the other hand, no statistically significant association between inter-district variation in women education and prevalence of modern family planning methods and female sterilization, appears to be due to highly skewed family planning method mix in favour of permanent methods of family planning, particularly female sterilization. The highly skewed family planning method mix in the state suggests that family planning practices in the state are oriented towards birth limitation rather than birth spacing. The data available from the National Family Health Survey, 2019-2021 suggest

that the prevalence of permanent methods of family planning, particularly female sterilization decreases with the increase in the education of women and female sterilization constitutes almost 80 per cent of the total modern family planning methods use in the state (Government of India, 2021). The prevalence of modern methods of family planning in the state has also been found to decrease with the increase in the number of years of schooling of women because the prevalence of female sterilization decreases with the increase in women years of schooling. The prevalence of modern methods family planning in the state is found to be the highest in women with no schooling (76 per cent) but the lowest in women with at least 12 years of schooling (53.7 per cent) because the prevalence of female sterilization is the highest in women with no schooling (70.7 per cent) but the lowest in women with at least 12 years of schooling (23.5 per cent) according to the National Family Health Survey, 2019-2021 (Government of India, 2021). The biasedness in the use of family planning methods towards permanent or terminal methods of family planning, especially female sterilization appears to be the reason behind no association between inter-district variation in women education and Inter-district variation in family planning use in the state. Female sterilization as a method of family planning in the state is found to be the choice of women with either no schooling or up to at the most 8 years of schooling.

The inter-district variation in women education in the state has also not been found to be statistically significantly associated with inter-district variation in child underweight and in women with low nutritional status or women having body mass index (BMI) less than 18.5 Kg/M^2. The no association between inter-district variation in women education and inter-district variation in child underweight appears to be conflicting association of inter-district variation in women education with inter-district variation in child stunting and inter-district variation in child wasting as the prevalence of child underweight is the combination of the prevalence of child stunting and the prevalence of child wasting. Similarly, inter-district variation in women education has not been found to be associated with inter-district variation in women with low BMI. It appears that the association of inter-district variation in women education with inter-district variation in the nutritional status of children and women is quite complex that needs further investigation.

Discussions and Conclusions

The inter-district variation in reproductive and child health status in Madhya Pradesh is quite marked because of the marked social, economic and cultural diversity of the districts of the state. There are districts where almost the entire population lives in the urban areas. At the same time, there are districts where the entire population is Scheduled Tribes. In such a marked social, economic and cultural diversity, reduction in inter-district variation in women education is advocated as a strategy to reduce inter-district variation in reproductive and child health situation as education empowers women to take decisions and actions which are directed towards improving their own health and health of their children. This argument hypotheises that a reduction in inter-district variation in women education may contribute to reduction in inter-district variation in reductive and child situation within the state. The present analysis, however, suggests that reduction in inter-district variation in women education may not contribute significantly to reducing inter-

district variation in some components of reproductive and child health. The analysis suggests that reducing inter-district variation in women education may have only a limiting role in reducing inter-district variation in reproductive and child health situation in the state. Inter-district variation in reproductive and child health status in the state may also be due to the inter-district variation in the availability and access to core reproductive and child health services. Data pertaining to inter-district variation in the availability and access to critical reproductive and child health services in Madhya Pradesh is, however, not available to analyse how controlling the inter-district variation in the availability and access to core reproductive and child health services influences the association of the Inter-district variation in women education with inter-district variation in different components of reproductive and child health. The inter-district variation in the availability and access to core reproductive and child health services can have a strong influence on inter-district variation in some of the components of reproductive and child health and may even camouflage the association with inter-district variation in women education.

From the policy and programme perspective, reducing inter-district variation in reproductive and child health situation is an operationally feasible yet effective strategy to improve reproductive and child health situation in the state. The present analysis, however, suggests that reduction in inter-district variation in women education can have only a limited impact in reducing inter-district variation in reproductive and child health situation in the state. Reduction in inter-district variation in women education in the state may be more effective in reducing inter-district variation in reproductive and child health situation when efforts are also made to reduce inter-district variation in the availability of and access to core reproductive and child health services.

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Appendix Table: Inter-district variation in indicators of women education and reproductive and child health in Madhya Pradesh, 2019-2021.

District	Women (15-49 years)								Children below 5 years of age		
	With 10 or more years of schooling	Aged 20-24 years married before 18 years of age	Who had last delivery in an institution	Whose last birth registered	Whose last birth was 3rd and higher order birth	Using a modern family planning method	Who are sterilised	With low BMI	Stunted	Wasted	Underweight
Agar Malwa	19.3	35.6	98.9	98.8	0.6	73.0	64.0	26.7	40.3	18.7	35.7
Alirajpur	17.3	30.7	83.2	87.0	5.0	72.2	61.2	19.6	34.6	15.4	31.6
Anuppur	28.6	18.6	84.8	96.5	2.1	57.6	52.2	26.5	24.0	18.4	30.7
Ashoknagar	17.6	29.7	91.3	91.6	3.4	68.2	57.8	26.1	32.6	19.7	31.1
Balaghat	39.2	4.4	95.1	97.3	1.3	70.1	60.0	30.2	41.9	20.5	44.9
Barwani	19.3	29.6	85.1	89.9	3.8	73.5	59.0	27.1	45.8	18.9	41.0
Betul	38.7	11.2	87.6	94.7	2.5	70.7	58.7	24.7	30.8	21.7	31.4
Bhind	28.9	25.1	93.5	93.1	2.2	48.5	38.4	24.3	32.2	12.4	29.0
Bhopal	47.4	11.3	98.3	94.5	0.5	73.7	46.4	18.2	19.9	20.6	29.1
Burhanpur	26.3	17.8	90.7	92.1	3.4	71.5	53.1	20.9	38.7	27.9	47.2
Chhatarpur	24.7	39.2	85.2	86.4	5.4	60.6	48.8	25.2	45.1	17.5	34.6
Chhindwara	40.2	11.6	92.2	95.9	2.6	74.2	65.4	28.5	23.9	18.1	32.8
Damoh	24.8	28.6	85.0	89.1	3.7	67.5	58.1	23.7	40.3	16.2	32.3
Datia	27.8	27.7	89.4	89.5	1.9	66.3	58.2	23.0	36.8	16.4	29.4
Dewas	27.7	28.1	92.2	94.7	1.9	61.2	45.5	22.5	36.8	20.4	30.7
Dhar	23.8	26.5	95.5	93.9	2.1	75.5	60.9	17.1	28.8	29.5	35.9
Dindori	25.8	21.1	77.6	98.1	3.0	70.4	62.4	29.3	38.9	15.8	33.6
Guna	17.7	28.1	98.0	97.1	2.8	69.2	56.6	18.4	31.9	10.1	25.1
Gwalior	37.9	11.8	94.8	94.5	3.0	51.5	36.5	20.4	40.1	12.4	33.0
Harda	30.8	10.0	88.4	93.3	0.6	75.5	57.0	15.9	38.8	28.0	34.7
Hoshangabad	35.5	16.7	91.8	93.6	2.7	28.0	20.0	21.9	34.8	19.5	27.2
Indore	47.7	21.7	96.5	96.6	1.9	79.6	47.9	15.6	28.7	21.2	24.9
Jabalpur	30.4	7.2	94.7	100.0	0.0	77.8	74.1	27.8	18.0	26.4	31.3
Jhabua	16.0	36.5	92.9	90.3	7.1	71.6	58.8	29.2	49.3	17.9	41.7
Katni	32.5	17.2	91.8	96.8	3.0	64.1	50.8	18.1	49.5	21.8	44.0
Khandwa (East Nimar)	27.9	10.8	93.2	93.1	2.0	71.1	64.8	21.7	38.4	20.7	35.3
Khargone (West Nimar)	27.2	13.3	92.8	94.6	2.7	75.0	62.4	16.7	31.4	27.4	44.0

District	Women (15-49 years)								Children below 5 years of age		
	With 10 or more years of schooling	Aged 20-24 years married before 18 years of age	Who had last delivery in an institution	Whose last birth registered	Whose last birth was 3rd and higher order birth	Using a modern family planning method	Who are sterilised	With low BMI	Stunted	Wasted	Underweight
Mandla	30.5	15.0	87.6	97.7	2.2	74.3	64.0	26.8	32.1	15.9	33.0
Mandsaur	24.1	34.8	99.4	98.0	0.4	64.8	48.1	29.4	30.9	13.1	22.9
Morena	25.6	27.8	94.8	93.3	4.5	51.8	42.5	22.3	40.0	10.1	29.6
Narsinghpur	31.4	19.6	91.4	98.1	3.4	70.4	63.4	25.1	32.0	19.6	28.1
Neemuch	27.9	29.3	97.5	99.6	1.2	66.3	48.9	18.8	33.0	13.1	27.7
Panna	24.0	22.8	84.0	87.5	5.0	57.8	47.0	26.8	45.1	23.2	39.2
Raisen	34.6	12.6	96.0	95.4	3.1	72.6	53.7	20.5	30.4	21.1	25.4
Rajgarh	21.3	46.0	91.7	90.5	3.1	59.7	42.7	28.0	27.6	22.4	26.8
Ratlam	23.8	31.3	95.2	97.3	2.1	68.3	51.6	23.4	29.0	16.2	28.6
Rewa	23.1	28.2	80.4	93.8	5.5	59.9	46.7	16.5	37.0	18.7	31.5
Sagar	32.9	21.4	86.9	93.6	3.2	60.9	47.5	22.8	42.7	15.2	35.8
Satna	31.5	12.9	85.5	95.1	5.7	61.2	52.1	21.3	49.4	16.8	31.2
Sehore	28.2	21.7	94.7	91.7	2.1	51.5	34.6	27.1	21.9	20.3	27.6
Seoni	33.0	11.2	94.8	98.4	2.7	74.5	65.0	26.6	23.5	21.1	31.1
Shahdol	30.7	27.5	85.6	98.4	2.5	58.3	47.1	28.3	44.0	20.4	39.2
Shajapur	19.6	24.4	98.1	96.3	1.9	71.8	53.4	23.1	27.8	23.4	27.6
Sheopur	15.9	39.5	84.2	86.2	4.1	63.5	51.8	30.5	45.8	16.2	37.7
Shivpuri	21.2	32.5	94.5	88.1	3.7	55.5	49.1	26.7	39.2	18.4	36.1
Sidhi	27.1	23.0	83.8	96.2	3.0	58.6	41.9	22.9	39.1	16.6	32.8
Singrauli	29.9	24.7	69.9	91.9	4.2	50.0	42.1	25.6	37.3	25.2	36.0
Tikamgarh	25.8	32.6	89.8	96.4	2.2	71.0	66.0	21.3	27.5	19.7	34.9
Ujjain	29.0	33.4	97.1	96.4	1.6	72.9	56.1	21.1	34.7	29.8	36.2
Umaria	26.4	21.2	92.2	97.0	4.3	60.5	49.6	21.1	45.3	15.5	36.6
Vidisha	21.7	22.8	90.6	96.7	4.9	64.6	44.7	23.1	36.5	16.6	34.4

Source: Government of India (*no date*).