Child Immunization in Madhya Pradesh

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India's National Family Health Survey (NFHS) was conducted in 1992–93 under the auspices of the Ministry of Health and Family Welfare. The survey provides national and state-level estimates of fertility, infant and child mortality, family planning practice, maternal and child health, and the utilization of services available to mothers and children. The International Institute for Population Sciences, Mumbai, coordinated the project in cooperation with 18 population research centres throughout India, the East-West Center in Honolulu, Hawaii, and Macro International in Calverton, Maryland. The United States Agency for International Development provided funding for the NFHS. The preparation and publication of this report were funded by the United Nations Population Fund (UNFPA).

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Abstract. *The 1992–93 NFHS provides considerable information on immunization coverage. Survey results indicate that the Government of India's Universal Immunization Programme (UIP) has met with only limited success in Madhya Pradesh, which is one of the most backward states in India. Only 29 percent of children age 12–23 months are fully immunized against the six diseases covered by the UIP—tuberculosis, diphtheria, pertussis (whooping cough), tetanus, polio, and measles. Another 37 percent are immunized against some, but not all, of these diseases, and 34 percent have not received any immunizations at all. Most of the children who are partly immunized have not been immunized against measles, indicating that the measles component of the immunization programme needs particular attention.*

This report estimates the effects of selected demographic and socioeconomic characteristics on immunization coverage. Children are more likely to be fully immunized if their mothers are more educated, if their mothers are at least 20 years old, and if their mothers received antenatal care. Children living in uncrowded households are more likely to be fully immunized than other children, and boys are somewhat more likely to be fully immunized than girls.

The analysis also shows that full immunization coverage reduces child mortality substantially. Among children surviving to age 12 months, the probability of dying between ages 12 and 48 months is 18 per 1,000 for fully immunized children and 64 per 1,000 for children who are not fully immunized. Other variables that have large effects on child mortality include antenatal care, birth order, and child's sex. Children of mothers who had antenatal care have lower mortality than other children. Children of lower birth orders have lower mortality than children of higher birth orders, and boys have somewhat lower mortality than girls.

Rakesh Munshi and Sang-Hyop Lee

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Immunization is a major focus of child survival programs throughout the world. Despite considerable gains in immunization coverage, however, at least two million children die from vaccine-preventable diseases every year, including more than a million from measles, 430,000 from neonatal tetanus, and close to 400,000 from pertussis (whooping cough) (WHO 1998).

The immunization of children against six potentially deadly, but preventable diseases—tuberculosis, diphtheria, pertussis, tetanus, polio, and measles—has been an important cornerstone of the child-health-care system in India. As part of the National Health Policy, the Expanded Programme on Immunization (EPI) was introduced in 1978 with the objective of providing free immunization services to all eligible children and expectant mothers (WHO 1986). Immunization against polio was introduced in the programme in 1979–80. BCG immunization against tuberculosis was brought under the EPI in 1981–82. The latest addition to the Programme, in 1985–86, was vaccination against measles. In order to step up the pace of immunization, the Universal Immunization Programme (UIP) was introduced in 1985–86 and is being implemented through the existing network of the primary health-care system, including Primary Health Centres (PHCs), sub-centres, and referral centres called Community Health Centres.

The Universal Immunization Programme has met with only limited success in Madhya Pradesh, which is one of the most backward states in India. Estimates from the 1992–93 National Family Health Survey (NFHS) indicate that, in Madhya Pradesh, 71 percent of children age 12–23 months are not fully immunized, and 34 percent have not received any immunizations at all. Partly because of low immunization coverage, infant and child mortality rates, although falling, are higher in Madhya Pradesh than in most other states of India. The low immunization coverage and high infant and child mortality rates are of considerable concern to both national and state governments. In this context, it is important to analyze immunization coverage and its effect on infant and child mortality in the state.

The 1992–93 NFHS provides considerable information on immunization coverage. Based on results from the survey, this report describes the extent of both full and partial immunization in Madhya Pradesh. The report goes on to estimate the effects of selected household demographic and socioeconomic characteristics on immunization coverage and the effect of immunization coverage on child mortality.

DATA AND METHODS

The NFHS was conducted in Madhya Pradesh between April and August 1992. The survey gathered information on a representative sample of 6,254 ever-married women age 13–49 residing in 5,857 households in the state. NFHS also collected information on 3,735 children born to these women in the four years preceding the survey.

The analysis of immunization coverage in this report focuses on the 887 children who were 12–23 months of age at the time of survey. This age group was selected because full immunization is recommended for all children by age one year. According to World Health Organization (WHO) guidelines, the recommended immunization schedule is: BCG immunization (against tuberculosis) at birth; three doses of DPT (diphtheria, pertussis, tetanus) vaccine and three doses of oral polio vaccine at 6, 10, and 14 weeks after birth; and measles immunization at nine months after birth. The analysis of the effect of immunization on child mortality focuses on children born in the period 12–47 months before the survey. The total number of children in this age group is 2,505. Details of the sample design are described in the state report for the NFHS in Madhya Pradesh (IIPS 1995).

Three types of questionnaires were used in the NFHS—one for households, one for ever-married women of childbearing age within households, and one for villages (the village questionnaire was administered only in rural areas). For this analysis, selected variables from the household questionnaire and the village questionnaire were merged into the data file for ever-married women. The child data file used in this report was then created from the augmented data file for women. Thus, the record for each child includes selected characteristics of the child, the child's mother, the mother's household, and (in rural areas) the mother's village.

The data file for ever-married women provides a complete birth history for each woman. For each child ever born to these women, the birth history includes year of birth, sex, birth order, survival status at the time of the survey, and age at death if the child is dead. The women's data file provides characteristics of the mothers of these children, including education, current age, age at childbirth, and exposure to mass media. The household data file provides information on household characteristics such as quality of the house, ownership of household goods, source of drinking water, type of toilet facility, source of lighting, and household head's religion and caste/tribe. The village data file provides information on such characteristics as access to transportation and health facilities.

The NFHS information on immunization coverage is derived from vaccination cards, if available, and from the mother's memory, if she could not show a card. Each mother was asked whether she had a vaccination card for each child born since January 1988. If a card was available, the interviewer copied the date for each vaccination from the card. If the mother could not produce a vaccination card, she was asked whether the child had received any vaccinations. If the child had been vaccinated, the mother was asked whether the child had received one or more vaccinations against each of the six diseases. For DPT and polio, information was obtained on the number of injections or oral doses given.

This report employs two statistical models. The first model, the immunization-coverage model, is used to estimate the effects of selected variables on immuniza-

tion coverage. The measure of a child's immunization is a binary variable that indicates whether the child has had all four vaccinations (BCG, measles, three doses of DPT vaccine, and three doses of polio vaccine). The analysis uses logit regression to estimate the unadjusted and adjusted effects of each predictor variable on child immunization. The second model, the child-mortality model, is used to estimate the effect of immunization on child mortality. In this model, child mortality is defined as the conditional probability of dying between the first and fourth birthdays among those who survive the first year (i.e., the fraction of one-year-olds who die before their fourth birthday). The analysis uses proportional hazard regression to estimate the unadjusted and adjusted effects of immunization on child mortality.

Neither model reports regression coefficients. Instead, regression results are transformed into simple cross-tabulations using multiple classification analysis. This involves calculating unadjusted and adjusted values of the response variable for each category of each predictor variable. These unadjusted and adjusted values are expressed as proportions—the proportion fully immunized in the first model and the proportion dying between the first and fourth birthdays in the second model. Unadjusted proportions are calculated from regressions that have only a single predictor variable. Adjusted proportions are calculated from regressions that include all the predictor variables. When calculating the adjusted proportions for a particular predictor variable, all other predictor variables are held constant (i.e., controlled) by setting them to their mean values in the underlying regression. Before calculating unadjusted and adjusted proportions, the constant term in each underlying regression is reset to a new value, chosen so that the predicted proportion generated by the regression equals the observed proportion when all predictor variables are set to their mean values. For further details of this methodology, see Retherford and Choe (1993).

The analyses of immunization coverage and child mortality use a number of predictor variables, including demographic variables, socioeconomic variables, and community variables. The list of variables is similar for both models, but with some differences. The main difference is that immunization coverage is excluded as a predictor variable from the immunization-coverage model, because immunization coverage is the response variable in that model. Another difference is that, in the child-mortality model, some predictor variables are dropped, and some variable categories are combined because of the small number of cases involved. For example, the three categories of mother's schooling in the immunization-coverage model (illiterate, literate with less than a middle school education, and literate with middle school complete or higher education) are collapsed into two categories (illiterate and literate) in the child-mortality model because mothers with middle or higher education had no dead children during the time period considered.

Among the predictor variables, mother's education is included because it strongly influences a mother's utilization of health services and because it is highly

correlated with family income, which also strongly influences utilization of services. Mother's age is included because it is strongly correlated with both health-seeking behavior and many of the other predictor variables. Mother's antenatal care is included because it is an important policy variable and because antenatal care is generally accompanied by strong motivational messages urging women to have their children immunized. Mother's exposure to mass media is included because mothers who are exposed to mass media are more likely to have access to information on immunization and other determinants of child health. Media exposure is also correlated with economic status, which influences utilization of health services and health generally. A mother is considered exposed to mass media if she listens to radio or watches television at least once a week or visits a cinema at least once a month. Mother's urban/rural residence is included because residence is highly correlated with access to health-care services.

Child's sex and child's birth order are included in both models. Child's sex is included because son preference, which is common in Madhya Pradesh, leads to different treatment of sons and daughters in terms of health care. Child's birth order is included because higher-order births are born into families that already have a number of young children who compete for resources and parental care (Pandey, Choe, and Luther 1998).

At the household level, household head's religion and caste/tribe[1] membership are included because they are correlated with health-seeking behavior and with many other predictor variables. Several variables representing household economic status—access to electricity, degree of crowding, and an index of ownership of household goods[2]—are included in both models because they affect the extent to which the household environment is conducive to health. Access to safe drinking water and access to a sanitary toilet facility are included because they directly affect health.

At the village level, availability of an all-weather road connecting the village to the outside is included because it is correlated with access to health-care facilities and with the general level of economic and social development of the village. Availability of a health-care facility in the village is also included. There are several types of health-care facilities in India. This analysis includes a measure of whether any of

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[1]Scheduled castes (SC) and scheduled tribes (ST) are castes and tribes identified by the Government of India as socially and economically disadvantaged and in need of special protection from social injustice and exploitation.

[2]A score for household economic status is based on ownership of household goods by adding the following points: 4 for ownership of a car; 3 each for ownership of a refrigerator, a television, a VCR/ VCP, or a motorcycle/scooter; 2 each for ownership of a sewing machine, a sofa set, a fan, a radio/transistor, or a bicycle; and 1 for ownership of a clock/watch. This score is used as an indicator of the standard of living of the household.

the following facilities is available in the village: Primary Health Centre, sub-centre, government hospital, private hospital, dispensary/clinic, or NGO family planning/ health clinic. For further detail on definitions of variables, see Tables 4 and 6.

IMMUNIZATION COVERAGE

This section describes how immunization coverage in Madhya Pradesh varies by type of vaccine and selected background characteristics. The issue of partial immunization is also addressed.

Proportions immunized

Figure 1 shows the extent of immunization coverage for children age 12–23 months by type of vaccine. As mentioned earlier, this age group was chosen for analysis because internationally accepted guidelines specify that children should be fully immunized by age one year. The coverage rate, defined in this way, varies by type of vaccine. Of the 887 children in the age group, 57 percent have received BCG vaccine, 47 percent have received three doses of polio vaccine, and 44 percent have received three doses of DPT vaccine. The coverage rates for polio and DPT are about the same because the two vaccines are usually administered together. The coverage rate for measles is 41 percent, lower than for the other immunizations.

Children who have received BCG vaccine, measles vaccine, three doses of DPT vaccine, and three doses of polio vaccine (not counting polio 0) are considered fully immunized. Based on this definition, only 29 percent of children age 12–23 months are fully immunized. Thirty-four percent have not received any immunizations. These

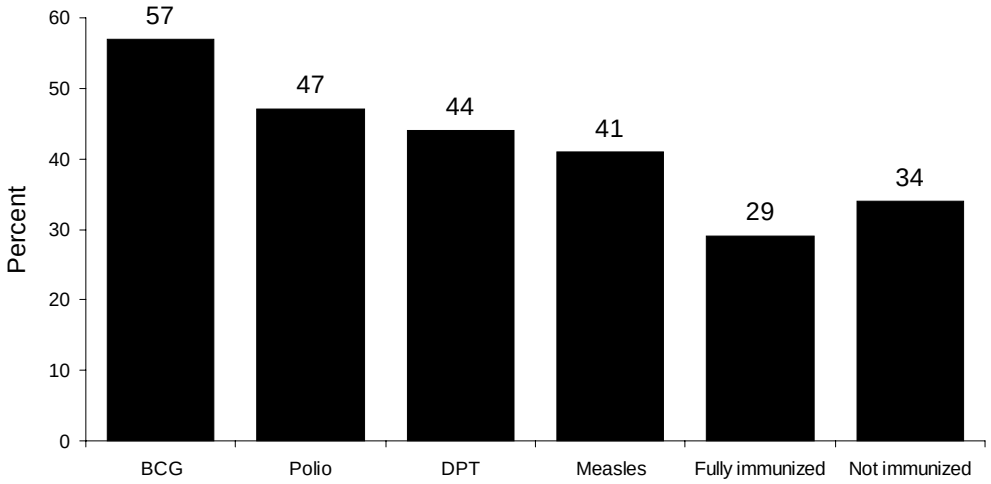

Figure 1 Percentage of children age 12–23 months who are immunized, by type of vaccine, Madhya Pradesh, 1992

findings indicate that Madhya Pradesh has a long way to go to achieve the goal of universal child immunization.

Table 1 shows the percentage of children age 12–23 months who received each vaccination at any time before the interview by source of information and selected demographic and socioeconomic characteristics. The estimates are based on information from both vaccination cards and mother's memory.

The first two rows of the table show immunization coverage by source of information. This could be from a vaccination card if the mother was able to show a card to the interviewer, or the source of information could be the mother's verbal report if she did not show a vaccination card but reported that the child had received one or more immunizations. Vaccination cards were available for only 22 percent of the

Table 1 Percentage of children age 12–23 months who received specific immunizations, by selected background characteristics, Madhya Pradesh, 1992

	Percentage vaccinated						Number of children
	BCG	DPT (3)	Polio (3)	Measles	All[a]	None	
Vaccination card	87	84	83	64	56	0	193
Mother's report	48	33	37	34	22	44	694
Mother's education							
Illiterate	49	35	38	33	22	41	679
Literate < middle school complete	73	60	64	55	42	20	98
Middle school complete	82	79	81	77	64	10	58
High school complete and above	98	90	91	79	67	0	52
Mother's age							
15–19	49	31	33	31	20	50	106
20–24	60	50	53	45	34	28	354
25–29	55	46	47	35	30	38	245
30–49	57	38	41	45	26	33	182
Child's sex							
Boy	59	47	49	44	33	31	461
Girl	54	41	44	37	26	38	426
Child's birth order							
1	62	50	52	47	37	31	246
2–3	57	48	50	39	30	34	348
4–5	50	37	43	36	22	39	184
≥ 6	53	29	31	39	22	37	109
Household head's religion							
Hindu[b]	56	43	45	40	29	35	828
Muslim	65	52	66	50	41	23	59
Household head's caste/tribe							
Scheduled caste/tribe	48	31	34	34	21	44	330
Other	62	51	54	45	35	29	557
Residence							
Urban	73	63	68	57	43	20	183
Rural	53	39	41	36	26	38	704
Antenatal care							
Yes	76	65	71	60	48	16	546
No	45	31	32	29	18	46	341
Total	57	44	47	41	29	34	887

Note: Percentages and numbers in this table and throughout the remainder of this report are based on the weighted sample, unless otherwise indicated.

[a]All vaccinations.

[b]Includes 14 children belonging to religions other than Hindu or Muslim.

children. Not surprisingly, levels of immunization coverage are much higher for children with vaccination cards than for children without them. Vaccination cards were available for a substantially higher proportion of boys than of girls and for a substantially higher proportion of children living in urban areas than of children in rural areas.

Immunization coverage increases with mother's education. The proportion of children who are fully immunized increases from one-fifth of children of illiterate mothers to two-thirds of children of mothers with at least a middle school education. Coverage is also higher for children of mothers who have received antenatal care than for other mothers. Forty-eight percent of children whose mothers received antenatal care are fully immunized, compared with 18 percent of children whose mothers did not receive antenatal care.

Hindu children are less likely to be fully immunized than are Muslim children (29 percent compared with 41 percent), and children from scheduled castes or scheduled tribes are less likely to be fully immunized than are other children (21 percent compared with 35 percent). Children of high birth order tend to have low immunization rates, partly because high-order births are disproportionately from rural areas where immunization services are less accessible.

Immunization coverage is higher for boys than for girls. Thirty-three percent of boys are fully immunized, compared with 26 percent of girls. The difference in coverage rates for boys and girls ranges from 5 percentage points for BCG vaccine to 7 percentage points for measles vaccine. These differences indicate that girls are discriminated against in the utilization of immunization services.

The coverage rate for each type of vaccine is much higher in urban areas than in rural areas. The proportion of children who are fully immunized is 43 percent in urban areas but only 26 percent in rural areas. There is not much difference, however, between urban areas and rural areas in immunization rates by selected demographic and socioeconomic background characteristics (not shown in the table). This suggests that the difference in immunization coverage between urban and rural areas is due mainly to differences in other demographic and socioeconomic background characteristics rather than to urban/rural residence per se. This point is discussed further in connection with Table 5.

Partial immunization

As mentioned earlier, 29 percent of children age 12–23 months are fully immunized, and 34 percent have not received any vaccinations. Sixty-six percent (100 percent minus 34 percent) have received at least one vaccination, implying that 37 percent (66 percent minus 29 percent) of children have had one or more vaccinations but are not fully immunized. These children are defined as partially immunized.

Table 2 Percentage of children age 12–23 months who were not fully immunized because they missed only one vaccination, Madhya Pradesh, 1992

	Missed BCG only	Missed DPT only	Missed polio only	Missed measles only	Number of children
Residence					
Urban	1.5	5.8	2.2	14.1	183
Rural	1.8	0.9	0.3	7.7	704
Child's sex					
Boy	2.6	1.5	0.6	7.9	461
Girl	0.7	2.3	0.3	10.1	426
Total	1.7	1.9	0.7	9.0	887

Table 2 shows the percentage of children who have received all but one vaccination. This table provides some insight into the causes of the low coverage rate for full immunization. Thirteen percent of children failed to reach full immunization because they missed only one vaccination. If these children had not missed one vaccination, full immunization coverage would be 42 percent instead of 29 percent. Among the 13 percent of children who missed one vaccination, 70 percent (9 out of 13 percentage points) missed the measles vaccination. Clearly the measles component of the immunization programme needs to be strengthened.

Table 3 shows the proportions of children who started but failed to complete the three-part series of DPT and polio vaccinations. The dropout rates between the first and third doses are 28 percent for DPT and 25 percent for polio. Among 539 children who received the first dose of DPT vaccine, 12 percent missed the second dose, and an additional 16 percent missed the third dose. Similarly, among 553 children who received the first dose of polio vaccine, 9 percent missed the second dose, and an additional 16 percent missed the third dose. Among children who receive the first dose of DPT or polio vaccine, those living in rural areas are less likely to complete the full series than are those living in urban areas. Girls are slightly less likely to complete the full series than are boys.

FACTORS AFFECTING FULL IMMUNIZATION

This section presents a multivariate analysis, based on logistic regression, of selected factors affecting full immunization rates. The analysis focuses on the 887 children born during the period 12–23 months before the survey.

Table 4 shows definitions and mean values of variables included in the immunization-coverage model. Mean values are presented for the whole state and for rural areas separately. Values for urban areas are not shown separately because the number of children in urban areas is too small to provide meaningful results—just over one-fifth of children covered by the survey live in urban areas. In the state as a whole, 52 percent of children age 12–23 months are male. Forty percent have mothers age 20–24, 77 percent have mothers who are illiterate, and 37 percent have moth-

Table 3 Percentage of children age 12–23 months who received one vaccination against DPT or polio but then dropped out before receiving the full course of vaccinations, Madhya Pradesh, 1992

	Percentage dropping out for DPT			Percentage dropping out for polio		
	Between dose 1 and 2	Between dose 2 and 3	Between dose 1 and 3	Between dose 1 and 2	Between dose 2 and 3	Between dose 1 and 3
Residence						
Urban	5	12	17	5	9	13
Rural	15	20	32	10	21	29
Child's sex						
Boy	10	19	27	8	17	24
Girl	15	17	29	9	18	25
Total	12	18	28	9	18	25

	Dose 1	Dose 2	Dose 3	Dose 1	Dose 2	Dose 3
Number of children who received each dose	539	473 (↓66)	388 (↓85)	553	505 (↓48)	417 (↓88)

ers who listen to radio or watch television at least once a week or visit a cinema at least once a month. Twenty-three percent of children age 12–23 months live in households with access to safe drinking water, and 40 percent live in households with an ownership-of-household-goods score greater than three. Thirty-seven percent live in households where the household head is from either a scheduled caste or a scheduled tribe.

The mean values for rural areas differ somewhat from those for the state as a whole, reflecting urban/rural differences in the subsample. For example, the proportion having access to safe drinking water is 11 percent in rural areas, compared with 23 percent for the state as a whole. The proportion who are Muslim is 3 percent in rural areas, compared with 7 percent for the state as a whole, reflecting the heavy concentration of Muslims in urban areas.

Table 5 and Figures 2 and 3 present estimation results for the immunization-coverage model. The discussion here focuses on the adjusted results. Mother's education has a substantial effect on child immunization. In the state as a whole, the proportion fully immunized is almost twice as high for children whose mothers have at least a middle school education (47 percent) as for children whose mothers are illiterate (26 percent). The proportion fully immunized is substantially higher for children of mothers age 20 and above (about 30 percent) than for children of mothers age 15–19 (18 percent). It is almost twice as high for children whose mothers received antenatal care (42 percent) as for children whose mothers did not receive antenatal care (23 percent), and it is almost twice as high for children living in households with less than three persons per sleeping room (39 percent) as for children living in households with three or more persons per sleeping room (23 percent). It is somewhat higher for boys (33 percent) than for girls (26 percent).

Table 4 Definitions and mean values of variables in the immunization-coverage model, Madhya Pradesh, 1992

Variable	Definition: Dummy variables with value 1 if the specified condition is met and 0 otherwise	Mean (%)	
		Whole state	Rural
Response variable			
Full immunization	Child has received BCG, measles, and three doses of DPT and polio vaccines	29	26
Predictor variables			
Mother's education			
Literate, < middle	Mother is literate with less than middle school complete	11	8
≥ Middle complete	Mother is literate with middle school complete or higher education	12	7
Mother's age			
20–24	Mother's age is 20–24 years	40	41
25–29	Mother's age is 25–29 years	28	26
30–49	Mother's age is 30–49 years	20	21
Media exposure	Mother watches television or listens to radio at least once a week or visits a cinema at least once a month	37	29
Antenatal care	Mother received antenatal checkup for this child	39	29
Child's sex	Child is a boy	52	51
Child's birth order			
2–3	Child's birth order is 2 or 3	39	41
4–5	Child's birth order is 4 or 5	21	20
≥ 6	Child's birth order is 6 or above	12	13
Muslim	Child lives in a household whose head is Muslim	7	3
Scheduled caste/tribe[a]	Child lives in a household whose head belongs to a scheduled caste or scheduled tribe	37	41
Household crowding	Child lives in a household with three or more persons per sleeping room	56	57
Score for ownership of household goods[b]	Child lives in a household with an ownership score of more than three	40	30
Safe drinking water	Child lives in a household that uses piped/tap water, hand pump, tanker truck, or bottled water as the main source of drinking water	23	11
Electricity	Child lives in a household that uses electricity as the main source of lighting	59	52
Residence	Child lives in urban area	21	—
Health-care facility	Child lives in a village that has a Primary Health Centre, sub-centre, government hospital, private hospital, dispensary/clinic, or NGO family planning/health clinic	—	56
All-weather road	Child lives in a village that is connected by an all-weather road	—	28
Number of children	Number of children age 12–23 months	887	704

[a]Scheduled castes and scheduled tribes are those castes and tribes identified by the Government of India as socially and economically disadvantaged and in need of special protection from social injustice and exploitation.

[b]Sum of points is as follows: 4 for car; 3 each for refrigerator, TV, VCR/VCP, motorcycle/scooter; 2 each for sewing machine, sofa set, fan, radio/transistor, bicycle; 1 for clock/watch.

None of the other predictor variables has an adjusted effect that is statistically significant. These variables have unadjusted effects that are statistically significant, but the effects disappear, or at least are no longer statistically significant, when all other variables are controlled.

The findings for rural areas are similar to those for the whole state. In rural areas, the adjusted full immunization rate is higher for first-born children than for second- or third-born children, and the difference is statistically significant. (For the state as a whole, it is also higher, but the difference is not statistically significant.) The additional village-level variables included in the rural model do not have statistically significant effects on immunization coverage after the other variables are controlled.

Table 5 Unadjusted and adjusted estimates of full immunization coverage for children age 12–23 months, Madhya Pradesh, 1992

	Percentage of children fully immunized			
	Whole state		Rural	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Mother's education				
Illiterate†	23	26	19	23
Literate, < middle school complete	43*	35	32*	24
≥ Middle school complete	66*	47*	64*	43*
Mother's age				
15–19†	20	18	16	12
20–24	34*	32*	31*	29*
25–29	30	30	23	24
30–49	26	29	22	27
Mother's media exposure				
Yes	44*	31	39*	28
No†	22	28	18	23
Antenatal care				
Yes	51*	42*	45*	38*
No†	20	23	17	19
Child's sex				
Boy	33*	33*	28*	28*
Girl†	25	26	21	21
Child's birth order				
1†	37	35	33	33
2–3	30	27	24*	21*
4–5	22*	26	19*	23
≥ 6	22*	29	21*	25
Religion				
Hindu†[a]	28	29	24	25
Muslim	40*	31	40	24
Scheduled caste or tribe				
Yes	21*	28	18*	23
No†	35	30	30	26
Household crowding				
0–2 persons per room†	43	39	37	33
≥ 3 persons per room	21*	23*	18*	20*
Score for ownership of goods				
0–3†	21	28	18	22
≥ 4	45*	32	38*	29
Safe drinking water				
Yes	44*	35	31	25
No†	25	27	23	25
Electricity				
Yes	38*	32	32*	27
No†	18	26	17	22
Residence				
Urban	43*	24	—	—
Rural†	26	31	—	—
All-weather road				
Yes	—	—	32*	26
No†	—	—	23	24
Health-care facility				
Yes	—	—	28	23
No†	—	—	22	26
Number of children	887	887	704	704

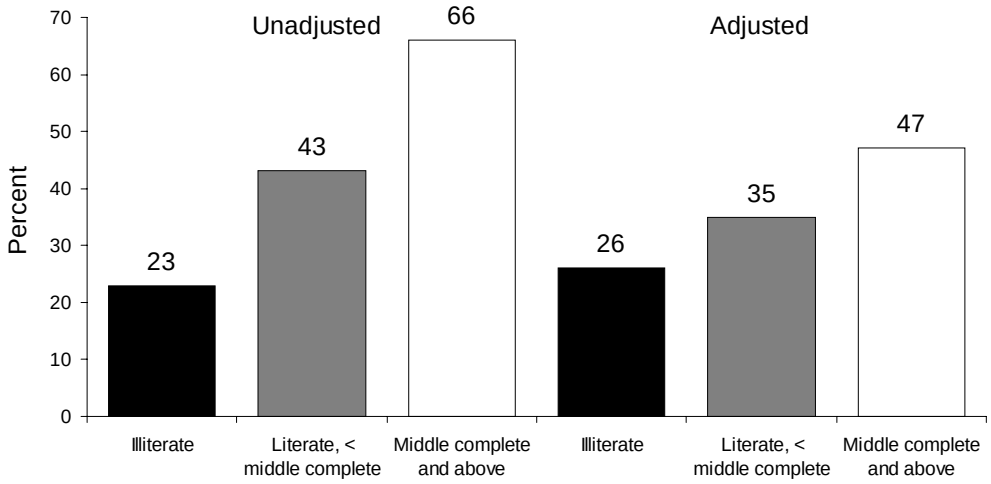

Figure 2 Unadjusted and adjusted rates of full immunization coverage among children age 12–23 months, by mother's education, Madhya Pradesh, 1992

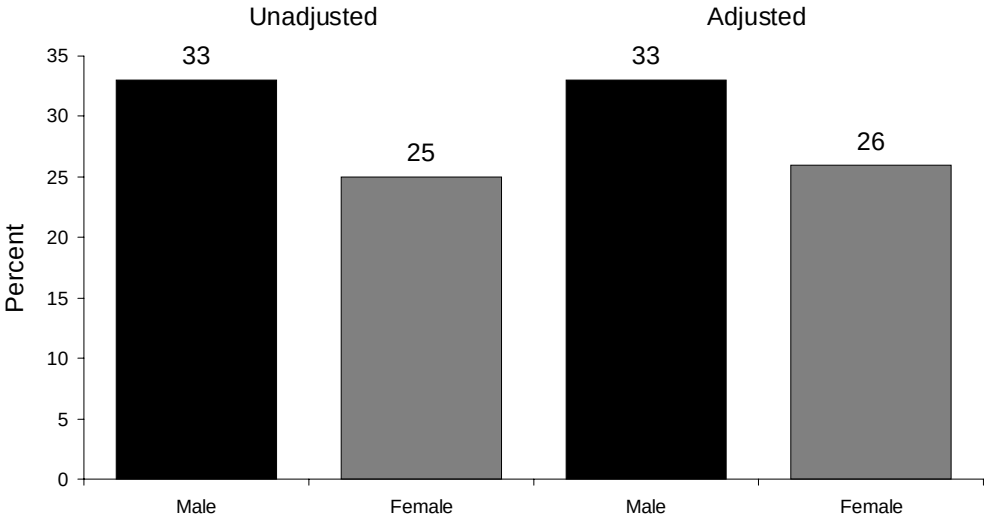

Figure 3 Unadjusted and adjusted rates of full immunization coverage among children age 12–23 months, by child's sex, Madhya Pradesh, 1992

Notes to Table 5:

Both unadjusted and adjusted values are estimated by logistic regression. Unadjusted values are based on separate logistic regressions for each covariate, with that covariate as the only predictor variable in the regression. Adjusted values are based on a single logistic regression that includes all the covariates in the table. For any given covariate in the adjusted column, the set of control variables consists of all the other covariates, which are set at their mean values.

†Reference category

*The coefficient in the underlying logistic regression differs significantly from zero at the 5 percent level.

[a]Hindu includes 14 children belonging to religions other than Hindu or Muslim.

THE EFFECT OF FULL IMMUNIZATION ON CHILD MORTALITY

This section presents a multivariate analysis, based on proportional hazard regression, of the effect of full immunization on child mortality after a number of potentially confounding demographic and socioeconomic variables are statistically controlled. The analysis focuses on 2,505 children born 12–47 months before the survey.

For a number of reasons, the results presented here must be interpreted with caution. It is not possible to analyze the impact of immunization on mortality of children during the first year of life because children are in the process of receiving their vaccinations during this period. Most child deaths occur during the first 12 months, however, so the analysis presented here is based on only 61 deaths that occurred between 12 and 48 months of age. This small number of deaths reduces the likelihood of obtaining statistically significant results. In addition, because the NFHS did not collect information on the incidence of the six diseases against which children are immunized, it is not possible to establish a causal relationship between immunization and death rates from specific diseases.

Table 6 shows definitions and mean values of variables included in the child-mortality model. Again, mean values are presented for the whole state and for rural areas separately. The mean values are close to those in Table 4 for the immunization coverage model. There are, of course, some differences, because the subset of children considered is different in the two models, and because some variables (most notably the maternal age variable) are specified differently in the two models.

Table 7 and Figure 4 present estimation results for the child-mortality model. The values shown are probabilities of dying between the ages of 12 and 48 months (per 1,000), conditional on survival to 12 months. This discussion focuses on the adjusted results.

Full immunization has a very large effect on child mortality, and this effect is not diminished very much by controlling for the other predictor variables. The adjusted probability of dying is 18 per 1,000 for fully immunized children and 64 per 1,000 for children who are not fully immunized.

Among the control variables, antenatal care has a large adjusted effect on the probability of dying. The adjusted probability of dying is 11 per 1,000 for children whose mothers received antenatal care and 89 per 1,000 for children whose mothers did not receive antenatal care. Sex of child also has a large effect. The adjusted probability of dying is 32 per 1,000 for boys and 61 per 1,000 for girls, indicating considerable discrimination against girls. The findings also indicate favored treatment of first-born children. The adjusted probability of dying is 23 per 1,000 for first-borns, 69 per 1,000 for second- and third-borns, and 70 per 1,000 for fourth- and fifth-borns. (The probability drops back to 21 per 1,000 for children of birth order 6 or higher, but this estimate is unreliable because it is based on only four deaths.)

Table 6 Definitions and mean values of variables for estimating the child-mortality model, Madhya Pradesh, 1992

Variable	Definition: Dummy variables with value 1 if the specified condition is met and 0 otherwise	Mean (%)	
		Whole state	Rural
Response variable			
Child mortality (per 1,000 children at risk)[a]	Conditional probability of dying between the first and fourth birthday for those who survive the first year	44	53
Predictor variables			
Full immunization	Child has received BCG, measles, and three doses of DPT and polio vaccines	30	26
Mother's literacy	Mother is literate	23	15
Mother's age at childbirth			
20–29	Mother's age at childbirth was 20–29	58	56
30–49	Mother's age at childbirth was 30 or above	15	15
Mother's media exposure	Mother watches television or listens to radio at least once a week or visits a cinema at least once a month	37	27
Antenatal care	Mother received antenatal checkup for this child	36	27
Sex of child	Child is a boy	52	50
Child's birth order			
2–3	Child's birth order is 2 or 3	39	39
4–5	Child's birth order is 4 or 5	19	19
≥ 6	Child's birth order is 6 or above	13	14
Muslim	Child lives in a household whose head is Muslim	6	3
Scheduled caste/tribe[b]	Child lives in a household whose head belongs to a scheduled caste or scheduled tribe	37	41
Household crowding	Child lives in a household with three or more persons per sleeping room	56	57
Score for ownership of household goods[c]	Child lives in a household with an ownership score of more than three	40	30
Safe drinking water	Child lives in a household that uses piped/tap water, hand pump, tanker truck, or bottled water as the main source of drinking water	26	13
Sanitary toilet facility	Child lives in a household that has own or shared flush toilet facility	11	3
Electricity	Child lives in a household that uses electricity as the main source of lighting	62	55
Residence	Child lives in urban area	21	—
Health-care facility	Child lives in a village that has a Primary Health Centre, sub-centre, government hospital, private hospital, dispensary/clinic, or NGO family planning/health clinic	—	59
All-weather road	Child lives in a village that is connected by an all-weather road	—	25
Number of children	Number of children age 12–47 months	2,505	1,987

[a]This variable is not a dummy variable.

[b]Scheduled castes and scheduled tribes are those castes and tribes identified by the Government of India as socially and economically disadvantaged and in need of special protection from social injustice and exploitation.

[c]Sum of points is as follows: 4 for car; 3 each for refrigerator, TV, VCR/VCP, motorcycle/scooter; 2 each for sewing machine, sofa set, fan, radio/transistor, bicycle; 1 for clock/watch.

None of the other control variables has a statistically significant adjusted effect on child mortality. In part, this is because there are small numbers of cases in some categories of some variables. The distributions of the sample based on mother's education, access to safe drinking water, and access to a sanitary toilet facility, for example, are highly skewed (as seen from Table 6), implying very small numbers of children in the 'literate' and 'yes' categories of these variables. This is, no doubt, the main reason why the large adjusted effects of these variables on child mortality in Table 7 are not statistically significant. Again, the results for rural areas resemble the

Table 7 Unadjusted and adjusted estimates of mortality between age 12 and 48 months for children surviving to age 12 months, Madhya Pradesh, 1992

	Probability of dying between 12 and 48 months (per 1,000)			
	Whole state		Rural	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Full immunization				
Yes	10*	18*	15*	22*
No†	66	64	75	76
Mother's education				
Illiterate†	66	52	69	59
Literate	10*	25	20*	37
Mother's age at childbirth				
< 20†	42	51	48	66
20–29	51	48	63	57
≥ 30	25	23	32	27
Mother's media exposure				
Yes	24*	37	35	41
No†	62	48	67	62
Antenatal care				
Yes	7*	11*	9*	11*
No†	109	89	124	113
Child's sex				
Boy	31*	32*	39*	39*
Girl†	62	61	73	72
Child's birth order				
1†	24	23	30	28
2–3	62*	69*	72*	80*
4–5	69*	70*	85*	84*
≥ 6	25	21	30	28
Religion				
Hindu†[a]	47	46	56	—
Muslim	16	21	25	—
Scheduled caste or tribe				
Yes	62*	48	66	55
No†	35	41	46	52
Household crowding				
0–2 persons per room†	43	48	50	54
≥ 3 persons per room	44	40	55	52
Score for ownership of goods				
0–3†	59	40	61	47
≥ 4	27*	50	43	64
Safe drinking water				
Yes	15*	26	32	36
No†	65	53	63	61
Sanitary toilet facility				
Yes	11	78	53	—
No†	52	40	55	—
Electricity				
Yes	38	47	50	56
No†	55	39	58	48
Residence				
Urban	13*	33	—	—
Rural†	60	48	—	—
All-weather road				
Yes	—	—	49	53
No†	—	—	54	53
Health-care facility				
Yes	—	—	50	47
No†	—	—	56	53
Number of children	2,505	2,459	1,987	1,950

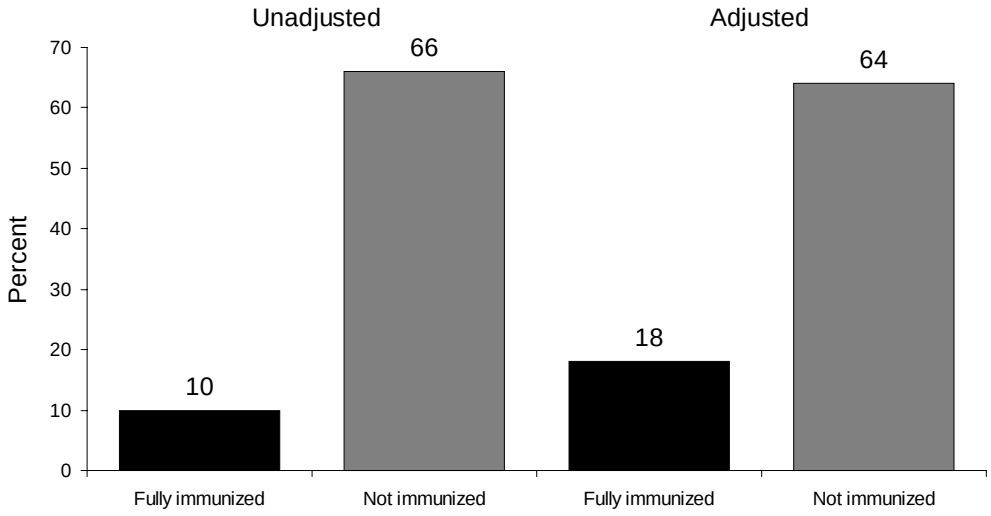

Figure 4 Unadjusted and adjusted proportion of children surviving to age 12 months who die between age 12 and 48 months, by immunization status, Madhya Pradesh, 1992

results for the state as a whole fairly closely, and, again, the village-level variables have no statistically significant adjusted effects.

SUMMARY AND POLICY RECOMMENDATIONS

NFHS findings on immunization coverage indicate that Madhya Pradesh has a long way to go to achieve the goal of universal immunization of children. Only 29 percent of children age 12–23 months are fully immunized, and 34 percent of children have not received any immunizations at all.

The results show that a particularly low rate of measles immunization and high dropout rates during the three-part DPT and polio vaccination series are the main causes of the low rate of full immunization. Thirteen percent of children age 12–23 months failed to reach full immunization because they missed only one vaccination. Among this 13 percent, 70 percent missed the measles vaccination. The dropout

Notes to Table 7:

Child mortality is defined as the probability of dying between 12 and 48 months (per 1,000), conditional on survival to 12 months. Both unadjusted and adjusted values are estimated by proportional hazard model regressions fitted to the unweighted data. Unadjusted values are based on separate hazard model regressions for each covariate, with that covariate as the only predictor variable in the regression. Adjusted values are based on a single hazard model regression that includes all the covariates in the table. For any given covariate in the adjusted column, the set of control variables consists of all the other covariates, which are set at their mean values.

†Reference category

*The value in the underlying hazard model regression differs significantly from zero at the 5 percent level.

[a]Hindu includes 14 children belonging to religions other than Hindu or Muslim.

rates between the first and third doses of DPT and polio vaccination are 28 and 25 percent, respectively.

The results from fitting the immunization-coverage model indicate that, after controlling for potentially confounding variables, mother's education, antenatal care, and sex of child all play important roles in explaining variations in immunization coverage. The full immunization rate is almost twice as high for children of mothers with at least a middle school education as for children of illiterate mothers, and almost twice as high for children whose mothers received antenatal care as for children of mothers who did not receive antenatal care. Boys have substantially higher immunization rates than girls, reflecting a strong preference for sons in Madhya Pradesh.

The results from the child-mortality model indicate that immunization of children has a very large effect on child mortality, even after potentially confounding variables are controlled. Among children who survive to 12 months, the adjusted probability of dying between 12 and 48 months is 18 per 1,000 for fully immunized children and 64 per 1,000 for children not fully immunized.

The low rates of immunization and the high dropout rates during the three-part DPT and polio vaccination series spotlight deficiencies in the health-care system. There is also a clear need to strengthen education programmes for mothers. It is essential that all mothers know why, when, where, and how often their infants should be vaccinated. The immunization programme in Madhya Pradesh also needs to address the problem of gender discrimination in the immunization of children.

REFERENCES

IIPS (International Institute for Population Sciences). 1995. *National Family Health Survey (MCH and Family Planning)*: *Madhya Pradesh*. Bombay: IIPS.

Pandey, Arvind, Minja Kim Choe, Norman Y. Luther, Damodar Sahu, and Jagdish Chand. 1998. *Infant and child mortality in India*. National Family Health Survey Subject Reports No. 10. Mumbai: International Institute for Population Sciences; and Honolulu: East-West Center.

Retherford, Robert D., and Minja Kim Choe. 1993. *Statistical methods for causal analysis*. New York: John Wiley and Sons.

WHO (World Health Organization). 1986. *The Expanded Programme on Immunization in South-East Asia.* SEARO Regional Health Papers 12: India. New Delhi: WHO.

———. 1998. Report of the Technical Review Group Meeting, 7–8 June 1998: Vaccine research and development. WHO/VRD/GEN/98.02. Geneva: WHO.