

NATIONAL FAMILY HEALTH SURVEY

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The NFHS BULLETIN summarizes findings from the 1992–93 National Family Health Survey. The NFHS collected information from nearly 90,000 Indian women on a range of demographic and health topics. The survey was conducted under the auspices of the Indian Ministry of Health and Family Welfare to provide 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 (IIPS), Mumbai, conducted the NFHS in cooperation with various consulting organizations and 18 population research centres throughout India and with the East-West Center in Honolulu, Hawaii, and Macro International in Calverton, Maryland. The U.S. Agency for International Development provided funding for the NFHS and for this publication.

Mother's Tetanus Immunisation Is Associated not Only with Lower Neonatal Mortality but Also with Lower Early-Childhood Mortality

Tetanus has long been a major killer of the newborn in India, especially in rural areas. Although mortality rates have fallen considerably in recent years, an estimated 200,000 newborns still die of tetanus annually (Dastur et al. 1993). Tetanus is preventable in newborns, however, because immunity can be transmitted from mother to child through the placenta. Two doses of tetanus toxoid vaccine given one month apart during pregnancy prevent nearly all tetanus infections in both mothers and their newborn children. The Indian National Immunisation Schedule, following guidelines of the World Health Organisation (WHO), recommends that a pregnant woman receive two doses of tetanus toxoid vaccine at 16 and 20 weeks into pregnancy. If the mother received two doses less than three years earlier during a previous pregnancy, a single booster is adequate.

The Indian Government began a concerted effort in 1975–76 to inoculate all pregnant women with the recommended tetanus toxoid vaccine. This effort was integrated into the Expanded Programme on Immunisation (EPI) in 1978 and then into the Universal Immunisation Programme in 1986. Nevertheless, the National Family Health Survey (NFHS), conducted in 1992–93, found that 40% of pregnancies in India were not covered by maternal tetanus immunisation. In Uttar Pradesh, India's most populous state, 56% of pregnancies were not covered.

This issue of the *NFHS Bulletin* uses data from the survey to examine how neonatal (first month) and early-childhood (1–47 months) mortality vary according to mother's tetanus immunisation. Controlling for the effects of 13 potentially confounding demographic and socioeconomic variables, the analysis shows that mother's tetanus immunisation is associated not only with reduced neonatal mortality, which is expected, but also with substantially reduced early-childhood mortality, which is a surprising result.

About the study

The study is based on NFHS data for India as a whole and for Uttar Pradesh. The NFHS collected information on tetanus immunisation for mothers of all children born during the four-year period preceding the survey. Analysis of neonatal mortality is based on 55,558 children at the national level and 9,613 children in Uttar Pradesh. Analysis of early-childhood mortality is based on 52,802 children nationally and 8,976 children in Uttar Pradesh.

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The analytical approach is multivariate and employs proportional hazard models. The principal predictor variable is whether the mother received at least two doses of tetanus toxoid vaccine during the pregnancy. Control variables are (1) number of times the mother visited a health facility for antenatal care during the pregnancy, (2) whether the mother received iron and folic acid tablets during the pregnancy, (3) whether the child was delivered in a medical institution, (4) the sex of the child, (5) the year of the child's birth, (6) the mother's age at the time of the child's birth, (7) whether the family lives in an urban area, (8) whether the mother is literate, (9) the religion and caste/tribe of the household head, (10) whether the mother is regularly exposed to radio or television, (11) whether the household has access to any kind of toilet facility, (12) whether the household uses a clean cooking fuel (not wood or dung), and (13) the economic level of the household measured in terms of a household-assets index.

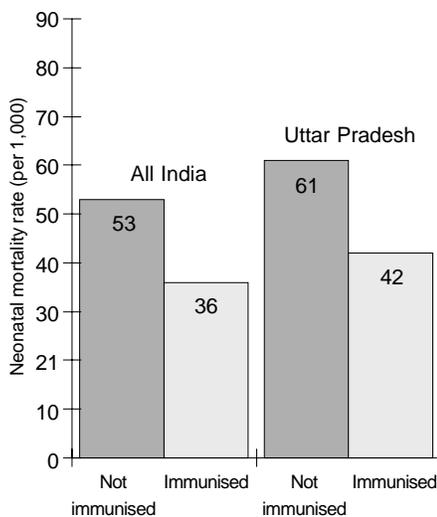


Figure 1. Model estimates of neonatal (first month) mortality by tetanus immunisation status of mother, controlling for 13 demographic and socioeconomic background variables, all India and Uttar Pradesh

These 13 control variables are the demographic and socioeconomic factors most commonly associated with infant and child mortality. They are held constant in the analysis by setting them to their mean values in the hazard regressions. More details on data and methods may be found in Pandey et al. (in preparation).

An unexpected finding

Figures 1 and 2 show, for India as a whole and for the state of Uttar Pradesh, the association between mother's tetanus immunisation and neonatal and early-childhood mortality. The estimates depicted in the figures incorporate controls for the 13 socioeconomic and demographic variables listed above. Surprisingly, the negative association between immunisation and mortality is stronger for early-childhood mortality than for neonatal mortality, both in India as a whole and in Uttar Pradesh. Tetanus immunisation is associated with a 32% reduction in neonatal mortality and a 36% reduction in early-childhood mortality at the national level and a 31% reduction in neonatal mortality and a 48% reduction in early-childhood mortality in Uttar Pradesh.

Table 1 shows the most significant variables associated with early-childhood mortality. The first and third columns show that the decline in early-childhood mortality associated with tetanus immunisation is larger than the effect of any of the other predictor variables except for the difference between very low and very high household economic levels. The coefficient of the tetanus-immunisation variable is by far the most statistically significant ($p < .0001$) of all the predictor variables.

The other 13 predictor variables mostly affect early-childhood mortality in the expected directions, although effects are sometimes small and not statistically significant. For India as a whole, early-childhood mortality is significantly lower among children who are male, children

whose mothers are in the middle of the reproductive age range, children whose mothers visited a health facility relatively often for antenatal care, children whose mothers are literate, children who live in rural households that use a clean cooking fuel, and children who live in households with a high economic level.

After all other variables are controlled, early-childhood mortality tends to be slightly higher among children born more recently in time (data not shown). Variables that have little impact on early-childhood mortality include whether the mother received iron and folic acid tablets, place of delivery, religion and caste/tribe, urban/rural residence, whether the mother is regularly exposed to radio or television, and whether the household has any kind of toilet facility (data not shown).

While maternal immunisation against tetanus would be expected to reduce neonatal mortality, the apparent negative effect on early-childhood mortality requires an explanation. It seems likely that tetanus

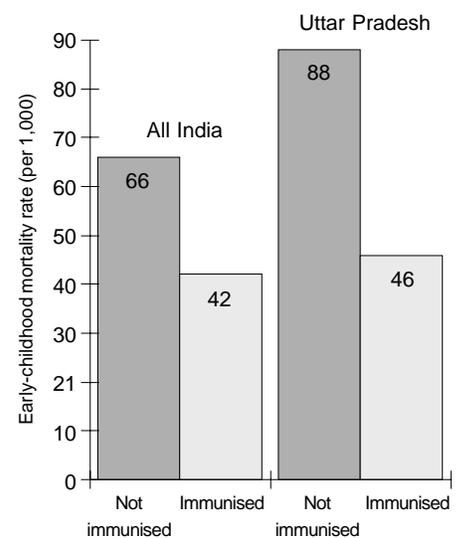


Figure 2. Model estimates of early-childhood (age 1–47 months) mortality by tetanus immunisation status of mother, controlling for 13 demographic and socioeconomic background variables, all India and Uttar Pradesh

nus immunisation is acting as a proxy for some more important, strongly correlated variable that is not included in the analysis. Perhaps the most likely variable is full immunisation of the child. Clearly there are problems in introducing child immunisation as a predictor variable because many of the children who die at an early age have not had time to be fully immunised. Yet child immunisation is still useful as a control—to see whether it removes much of the surprisingly substantial improvement in early-childhood survival associated with maternal immunisation against tetanus.

As shown in the second and fourth columns of Table 1, the introduction of child immunisation (whether the child is fully immunised or not) as an additional control variable reduces the estimated ‘effect’ of maternal tetanus immunisation, as well as the effects of most of the other important predictor variables, by 25–30%. Even after child immunisation is controlled, however, maternal tetanus immunisation still has the strongest association with reduced early-childhood mortality of any predictor variable. At the national level, with child immunisation controlled, estimated early-childhood mortality is still 27% lower among children whose mothers were immunised against tetanus than among children whose mothers were not immunised. In Uttar Pradesh, the difference is 40%. The effect remains highly significant ($p < .001$) in both cases.

In search of other variables for which maternal tetanus immunisation might be acting as a proxy, the analysis introduced birth order and length of previous birth interval (interval between the birth of the child and the mother’s previous birth) into the hazard model as additional variables. Although both are important predictor variables of early-childhood mortality, as controls they reduce neither the magnitude nor the significance of the association between early-childhood mortality and maternal tetanus immunisation.

Table 1. Model estimates of early-childhood mortality (probability of dying between the ages of 1 and 48 months), by mother’s tetanus immunisation status and selected demographic and socioeconomic variables, with and without an additional control for child immunisation status (CIS), all India and Uttar Pradesh

Predictor variable	All India		Uttar Pradesh	
	Without CIS	With CIS	Without CIS	With CIS
Mother received at least two doses of tetanus toxoid vaccine during pregnancy?				
No ^a	66	62	88	84
Yes	42*	45*	46*	50*
Sex of child				
Male	47*	48*	64	65
Female ^a	58	57	75	74
Mother’s age at time of child’s birth				
15	59*	60*	84*	87*
20	52*	52*	71*	72*
25	49*	49*	65*	65*
30	50*	50*	65*	64*
35	54*	54*	71*	70*
40	63*	62*	84*	84*
Number of antenatal care visits made by mother				
0	58*	56*	75	73
2	52*	52*	64	65
4	47*	48*	55	58
6	42*	45*	47	51
Literacy of mother				
Illiterate ^a	57	56	75	73
Literate	43*	46*	52*	57
Residence and whether household used clean cooking fuel				
Urban, does not use	54	52	65	67
Urban, uses	56	57	119	113
Rural, does not use ^a	52	52	66	66
Rural, uses	37*	40	79	84
Residence and economic level (measured by a household-assets index)				
Urban, economic level 0	61	57	75	73
Urban, economic level 10	41*	42	50	55
Urban, economic level 20	28*	31*	33	42
Rural, economic level 0 ^a	58	57	75	72
Rural, economic level 10	47*	50	70	72
Rural, economic level 20	38*	44	66	73

^aReference category

*Underlying hazard regression coefficient is significant at 5% level ($p < .05$)

Note: Within a column, child-mortality rates are estimated from a single hazard regression so that rates tabulated by one predictor variable incorporate controls for all the 13 other predictor variables (plus CIS in the second and fourth columns). The underlying hazard models incorporate terms for interaction between rural/urban residence and each of the following: access to any kind of toilet facility, use of a clean cooking fuel, and economic level. Variables are controlled by setting them at their mean values.

The association of maternal tetanus immunisation with reduced early-childhood mortality also persists throughout the age range. National-level data were analysed separately for deaths between 1 and 11 completed months of age and deaths between 12 and 47 completed months. The association with maternal tetanus immunisation is highly significant for both age groups. In fact, the association is slightly stronger for the older age group.

Discussion

Maternal tetanus immunization during pregnancy is recognised as almost sure protection against tetanus in the mother and the newborn child. Results from the 1992–93 NFHS, however, indicate that maternal tetanus immunisation is associated with reduced child mortality not only during the first month of life but also during a much longer subsequent period.

Is there a link? The duration of immunity against tetanus transmitted by mother to child through the placenta is thought to be short, and, at any rate, child mortality after the first month of life is rarely caused by tetanus. Thus there is no known or suspected medical explanation for the prolonged 'protection' of children associated with mothers' tetanus immunisation. Instead, maternal tetanus immunisation may be viewed simply as a good indicator of a

mother's general health-seeking behaviour. Indeed, it appears to be as good or better an indicator, at least at the national level and in Uttar Pradesh, as any of the well-accepted indicators such as mother's education or household economic level.

If tetanus immunisation during pregnancy is indeed a good proxy for health-seeking behaviour, it could serve as a useful tool for programme evaluation and policymaking. For example, if maternal immunisation against tetanus is part of a maternal and child health programme, then an evaluation of that programme might conveniently use the proportion of pregnant women in the area who were immunised as an indicator of general programme effectiveness.

Where government or private resources are scarce relative to need, such resources might be concentrated on regions, programmes, or population groups that appear relatively disadvantaged by this criterion. Of course, programme providers should not knowingly be evaluated solely on the basis of their success in tetanus immunisation or they might be tempted to place too much emphasis on tetanus immunisation relative to other services, making the tetanus-immunisation indicator invalid.

In areas where tetanus immunisation is generally available, maternal and child

health programmes should identify those women who do not receive tetanus immunisation during pregnancy and classify their children as a potentially high-risk group. Public-health education programmes designed to persuade these women to be immunised against tetanus should make sure that they receive information about other health risks that threaten infants and children.

It might also be useful for health workers and investigators to identify any other health-seeking behaviours that tend to characterise women who are immunised against tetanus during pregnancy. Promotion of such behaviours might then be incorporated into health education programmes aimed at women who are not immunised.

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