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Ravilla Anandaiah and Minja Kim Choe

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East-West Center, Population and Health Studies
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India's first National Family Health Survey (NFHS-1) 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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Correspondence addresses:
International Institute for Population Sciences
Govandi Station Road, Deonar, Mumbai - 400 088, India
Fax: 91-22-556-3257 • E-mail: iips.nfhs@axcess.net.in

East-West Center, Population and Health Studies
1601 East-West Road, Honolulu, Hawaii 96848-1601, U.S.A.
Fax: 1-808-944-7490 • E-mail: poppubs@ewc.hawaii.edu

Are the WHO Guidelines on Breastfeeding Appropriate for India?

Abstract. *Using data from India's first National Family Health Survey, conducted in 1992–93, this report examines factors affecting breastfeeding practices and the effect of breastfeeding on mortality at each month of infancy. The analysis is done separately for three groups of states classified according to their levels of infant mortality: high-mortality states, medium-mortality states, and low-mortality states.*

Breastfeeding is nearly universal in India and continues for most children beyond infancy. For many infants, however, supplemental food is introduced at an early age. Up to six months of age, exclusive breastfeeding is most common in medium-mortality states followed by states where infant mortality is high. In all three groups of states, infants who live in rural areas, whose mothers are illiterate, and whose families have low economic status are more likely than other infants to be exclusively breastfed.

The World Health Organization (WHO) recommends that children in developing countries should be exclusively breastfed up to 4–6 months of age. According to NFHS-1 results, both exclusive and nonexclusive (i.e., supplemented) breastfeeding lower mortality during early infancy. A surprising finding, however, is that breastfeeding with supplements is more beneficial than exclusive breastfeeding, even for children at very young ages (less than four months). The reason for the less-than-expected beneficial effect of exclusive breastfeeding appears to be that mothers who are poorly nourished and in poor health themselves may not provide adequate breast milk for their growing infants.

These results call into question the WHO recommendation that children be exclusively breastfed up to age 4–6 months. They suggest that supplemental food should be introduced at earlier ages, especially when a mother's health and nutritional status are low. In such situations, it appears that mother's milk is frequently not adequate to provide the level of nutrition that a growing infant requires. It also appears that the dangers of disease contamination from supplemental foods may not be as great as commonly thought, at least not in India. Thus it may be possible to reduce infant mortality in India by introducing nutritious supplemental food for children at quite young ages (2–3 months) as well as by providing poorly nourished pregnant and lactating mothers with nutritional supplements. Further research is needed to explore the relationship

between the nutrition and health of mothers and the effects of breastfeeding on infant mortality in India and in other developing countries.

Ravilla Anandaiah and Minja Kim Choe

Ravilla Anandaiah is State Demographer, Directorate of Family Welfare, Tamil Nadu, India. He was a Visiting Fellow at the East-West Center when this report was prepared. Minja Kim Choe is a Senior Fellow in Population and Health Studies at the East-West Center.

It is well known that breastfeeding practices can have a substantial effect on infant health and mortality in developing countries. There are at least three known mechanisms by which breastfeeding contributes to infant health and survival. First, breast milk is ideally suited to the baby's metabolic structure and contains the optimal combination of nutrients. Second, breastfeeding allows the mother to pass on immunities that she herself has acquired to the baby. For example, diarrhea-preventing immunoglobulin (IgA), which does not pass through the placental barrier in sufficient amounts during pregnancy, is passed on to infants through breastfeeding. Third, breastfeeding children receive less of other foods and liquids that could be contaminated with disease-causing agents (Briend, Wojtyniak, and Rowland 1988; Cabigon 1997; Habicht, DaVanzo, and Butz 1986; Huffman and Lamphere 1984; Jelliffe and Jelliffe 1978; Palloni and Tienda 1986; Yoon et al. 1996).

Previous studies have found that the positive effect of breastfeeding on infant survival is most pronounced in communities with high infant mortality and poor socioeconomic conditions. The protective effect of breastfeeding on child survival is particularly strong among children who live in rural areas (Goldberg et al., 1984), who come from poor families, whose mothers have little education (Palloni and Tienda, 1986; Retherford et al. 1989), and whose families lack access to safe drinking water and sanitary toilet facilities (Butz, DaVanzo, and Habicht 1982). This is not surprising, inasmuch as the nutrient content and sanitary preparation conditions of breast-milk substitutes tend to be affected by mother's education, the economic conditions of the family, and the level of environmental sanitation of the household and the community.

The protective effect of breastfeeding tends to be greater for infants at young ages than for older infants (Cabigon 1997; Majumder 1991). This occurs because the child's ability to digest food other than mother's milk and to resist disease-causing agents increases with age. At the same time, the benefits of breastfeeding, in combination with supplemental food, are found to continue well beyond the first year of life, especially in developing countries. Some reports document that in communities with a high prevalence of malnutrition and poor sanitation, breastfeeding substantially enhances child survival up to three years of age (Briend, Wojtyniak, and Rowland 1988; Molbak et al. 1994).

Based on such findings, the World Health Organization (WHO) recommends a set of guidelines for infant feeding in developing countries. There are four basic recommendations. First, breastfeeding should be initiated immediately after childbirth. Second, infants should receive only breast milk up to 4–6 months of age. At such young ages, no other foods or liquids are recommended. Third, starting at age 4–6 months, adequate and appropriate supplementary foods should be added to the infant's diet in order to provide sufficient nutrients for optimal growth. Fourth, it is recommended that breastfeeding continue, in combination with supplementary foods, up to the second birthday or beyond (World Health Organization 1991, p. 4).

Only a few empirical studies have distinguished between the effects of exclusive and nonexclusive (i.e., supplemented) breastfeeding on mortality at different ages during infancy, and the findings of these studies are not consistent. One study in Cameroon, based on 1978 survey data, reports that exclusive breastfeeding lowers mortality risk more than nonexclusive breastfeeding for children under four months of age. The study reports mixed results at ages 4–11 months. At ages 12 months and older, nonexclusive breastfeeding lowers mortality risk more than exclusive breastfeeding (Defo 1997). The Cameroon study uses both retrospective and prospective data. Results based on the prospective data show that exclusive breastfeeding is more beneficial than nonexclusive breastfeeding throughout the first year, whereas results based on the retrospective data are inconsistent.

This report focuses, first, on factors affecting exclusive and nonexclusive breastfeeding and, second, on the effects of exclusive and nonexclusive breastfeeding on infant mortality. Although infant mortality has fallen substantially in India in recent years—from 102 deaths per 1,000 live births for children born in 1981 to 79 deaths per 1,000 live births for children born in 1990 (Pandey et al. 1998, p. 25)—it continues to be high by international standards. Within India, state-level infant mortality rates range from a low of 24 deaths per 1,000 live births in Kerala to a high of 112 deaths per 1,000 live births in Orissa, indicating considerable scope for improvement in infant survival in many states. The objective of this analysis is to shed light on how infant survival in India can be improved by modifying infant-feeding practices and to evaluate the appropriateness of the WHO guidelines for breastfeeding—especially the guideline recommending exclusive breastfeeding up to age 4–6 months.

Because breastfeeding practices, infant mortality, and the effects of breastfeeding on mortality are all known to change with child's age, it is necessary to estimate the effects of breastfeeding practices on mortality over the period of infancy on a monthly basis. In assessing these effects, it is important to control for economic and other characteristics of parents, because these characteristics tend to be correlated with both breastfeeding practices and infant mortality. Previous studies have shown that breastfeeding behavior depends on the characteristics of households and parents, and India is no exception. Mothers who live in urban areas, who are literate, or who are from households with a high economic status tend to breastfeed their children less frequently and for a shorter duration than do other mothers (IIPS 1995). These same characteristics, however, are associated with low infant and child mortality (IIPS 1995; Pandey et al. 1998). In this study, we examine the effect of breastfeeding practices on mortality during the postneonatal period (ages 1–11 months) on a month-to-month basis, using multivariate statistical models to control for the effects of selected socioeconomic background variables, antenatal and delivery care variables, and demographic variables.

The analysis is based on data from India's first National Family Health Survey (NFHS-1), conducted in 1992–93. This survey provides a rare opportunity for such a study. The NFHS-1 sample size is large, so that there are adequate numbers of deaths to analyze, and the survey collected the necessary information for a month-to-month analysis. Data are analyzed separately for three groups of states, with low, medium, and high levels of infant mortality. First we examine the effects of selected socioeconomic background variables, antenatal and delivery care variables, and demographic variables on breastfeeding practices. Then we examine the effects of exclusive and nonexclusive breastfeeding at each month of infancy (from first through twelfth month) on mortality during the following three months. We choose a three-month exposure period for the mortality analysis in order to have a sufficient number of deaths to analyze at each month of age. Throughout the analysis, the effects on mortality of potentially confounding variables are statistically controlled.

DATA

NFHS-1, conducted in 1992–93, contains information from a probability sample of 89,777 ever-married women age 13–49 years. The survey covered 24 states and the National Capital Territory of Delhi, comprising 99 percent of India's population. It used a systematic, multistage, stratified sample design, resulting in samples of 3,000 to 5,000 households per state, except in Uttar Pradesh, where the sample size was about 10,000 households, and in the small northeastern states where the sample sizes were about 1,000 households per state. Thus, the sampling fraction varies from state to state. In states where the urban population was not sufficient to provide a sample of at least 1,000 completed interviews with eligible women, urban areas were oversampled (IIPS 1995). In the analysis, weights are used to restore the correct proportion of urban population in each state and to restore the correct relative sizes of state populations when the analysis is done for groups of states.

The survey includes complete birth histories of women, including each child's date of birth, sex, and survival status. For children who died before reaching their first birthday, the birth histories include age at death in completed months. From this information we constructed a set of variables indicating survival status at the beginning of each month of infancy.

For children born during the four years before the survey, mothers were asked questions on breastfeeding behavior including:

- Whether the infant was ever breastfed
- How many months the mother continued breastfeeding
- At how many months after birth the infant was given plain water, other milk, other liquids, or solid or mushy food on a regular basis

From these data we ascertained breastfeeding status at each month during the first year of life. Breastfeeding status was coded into three categories: exclusive breastfeeding, nonexclusive breastfeeding (i.e., breastfeeding with supplements), or no breastfeeding.

States of India vary widely in socioeconomic conditions and levels of infant mortality. Because the effect of breastfeeding on infant mortality varies at different levels of mortality, we divided the major states into three groups according to levels of infant mortality estimated from NFHS-1. Table 1 shows the three groups of states and the numbers of children on which the infant mortality rates are based. The first group consists of those states where the estimated infant mortality rate was 85 or higher deaths per 1,000 live births in 1988–92. These are Orissa, Uttar Pradesh, Bihar, Assam, and Madhya Pradesh. The second group consists of states where the estimated infant mortality rate ranged from 68 to 75 deaths per 1,000 live births. These are West Bengal, Haryana, Rajasthan, Andhra Pradesh, Gujarat, and Tamil Nadu. The third group consists of states where the estimated infant mortality rate was 65 deaths per 1,000 live births or lower. These are Karnataka, the National Capital Territory of Delhi (now a state), Himachal Pradesh, Punjab, Maharashtra,

Table 1 Infant mortality rates by state, NFHS, 1992–93

State	Infant mortality rate, 1988–92	Unweighted number of children[a]	Weighted number of children[a]
India	79	50,456	53,992
High-mortality states	96	21,288	26,198
Orissa	112	2,756	2,182
Uttar Pradesh	100	8,428	11,348
Bihar	89	4,345	6,754
Assam	89	2,069	1,793
Madhya Pradesh	85	3,690	4,121
Medium-mortality states	71	13,363	16,125
West Bengal	75	2,257	3,662
Haryana	73	2,109	1,330
Rajasthan	73	3,156	2,867
Andhra Pradesh	70	1,897	3,156
Gujarat	69	2,269	2,606
Tamil Nadu	68	1,675	2,504
Low-mortality states	52	15,805	11,669
Karnataka	65	2,553	2,772
Delhi	65	2,280	687
Himachal Pradesh	56	1,546	302
Punjab	54	1,948	1,404
Maharashtra	51	2,355	4,853
Jammu region of Jammu and Kashmir	45	1,898	270
Goa	32	1,351	53
Kerala	24	1,874	1,328

Source: IIPS 1995, Table 8.8 for infant mortality.

[a]Based on children born during the four years before the survey.

the Jammu region of Jammu and Kashmir, Goa, and Kerala. The six small northeastern states—Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura—are excluded from the analysis.

Breastfeeding is nearly universal in India: 95 percent of all children born during the four years before NFHS-1 were breastfed. Breastfeeding generally continues beyond infancy: The median length of breastfeeding is slightly more than two years (IIPS 1995, pp. 271, 279). Specific breastfeeding practices do not necessarily follow WHO recommendations, however. Most women do not immediate initiate breastfeeding right after childbirth: Only 26 percent of children who were ever breastfed started breastfeeding within one day of birth. Many women in India squeeze and discard the first milk from the breast: Only 37 percent of children who were ever breastfed received their mother's first milk. Although WHO recommends exclusive breastfeeding during the first 4–6 months of life, only about one-half of children under four months old were receiving mother's milk exclusively at the time of the survey. Contrary to the WHO recommendation to continue breastfeeding and add complementary foods at about age six months, only about three-fourths of children at age 7 and 11 months receive breastfeeding with supplementation.

METHODS

In this analysis, breastfeeding status is defined at each month of the first year of life as either exclusive breastfeeding, nonexclusive breastfeeding, or no breastfeeding, based on information on (1) whether the child was ever breastfed, (2) the duration of breastfeeding in months, and (3) the age at which water, other milk, other liquid, or solid or mushy food was first introduced.[1] These three categories of breastfeeding status are represented by two dummy variables, one for exclusive breastfeeding and one for nonexclusive breastfeeding, with no breastfeeding as the reference category.

The effects of the predictor variables on breastfeeding practices (i.e., on type of breastfeeding) are estimated by multinomial logistic regression for each of the three groups of states. The effects are estimated separately for children age 2 months, 7 months, and 11 months. Altogether, nine multinomial regressions are estimated. The predictor variables include socioeconomic background variables, antenatal and delivery care variables, and demographic variables.

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[1]The number of children who received breast milk and plain water is too small, in most instances, to be treated as a separate category. In cases where numbers are sufficient to treat 'breastfeeding with plain water' as a separate category, the effects on infant mortality are more similar to the effects of 'breastfeeding with supplements' than to the effects of exclusive breastfeeding. Therefore, in this analysis, 'breastfeeding with plain water' is included in the category of 'breastfeeding with supplements' (i.e., nonexclusive breastfeeding).

The effects of breastfeeding practices (represented by the two dummy variables for exclusive and nonexclusive breastfeeding) on postneonatal mortality are estimated using ordinary logistic regression, controlling for the effects of socioeconomic background variables, antenatal and delivery care variables, and demographic variables. The logistic regression models are estimated separately for each of the three groups of states and separately for 12 ages—0, 1, …, 11 months. Corresponding to these ages are 12 subsequent three-month periods during which infants are exposed to the risk of dying—age 1–3 months, 2-4 months, 3-5 months, and so on, up to age 12-14 months. Two categories of children are excluded from the analysis (censored cases): Children who died before reaching the beginning of the relevant three-month period and children who survived but for whom the three-month period had not ended at the time of the survey. All together, 36 logistic regressions are estimated.

The explanatory variables in the regression models include socioeconomic background variables, antenatal and delivery care variables, and demographic variables previously identified as having statistically significant effects on postneonatal mortality (IIPS 1995; Pandey et al. 1998). The socioeconomic background variables are urban/rural residence, mother's literacy, religion of the household head (Hindu, Muslim, and other), whether the household head belongs to a scheduled caste or scheduled tribe,[2] and an estimate of household economic status based on the ownership of household goods.[3] The antenatal and delivery care variables include whether the mother received at least one antenatal check-up, whether she received two or more tetanus injections during pregnancy, and whether the child was delivered at a medical facility. The demographic variables include child's birth order, whether the child was born within two years after the birth of the previous child, whether any of the older siblings had died, mother's age at childbirth (under 20 years, 20–34 years, or 35 years or older), and sex of child. Before finalizing the models for the mortality analysis, we tested models that included interaction terms between breastfeeding practices and the other predictor variables. The interaction terms were found not to be statistically significant in most models and were not included in the final models.

[2]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.

[3]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 minimum possible score is 0 and the maximum possible score is 27.

BACKGROUND CHARACTERISTICS OF CHILDREN

Table 2 shows mean values of the predictor variables for each of the three groups of states classified according to infant mortality levels. Children are only included who were born during the four-year period before the survey, who survived the first month of life, and for whom information is available on the variables listed in the table.

Not surprisingly, the proportion of children who live in rural areas and the proportion whose mothers are illiterate are highest in the high-mortality states and lowest in the low-mortality states. The proportion of children who are neither Hindu nor Muslim is highest, and the proportion who belong to a scheduled caste or scheduled tribe is lowest, in the low-mortality states. Household economic status is highest in the low-mortality states and lowest in the high-mortality states.

Again not surprisingly, children in low-mortality states are most likely to have mothers who obtained antenatal care, received at least two tetanus injections, or delivered in a medical facility. Children in high-mortality states are least likely to have mothers who received these services. The differences among the three groups of states in levels of antenatal and delivery care are substantial. Surprisingly, the proportion of children born after a short birth interval (less than 24 months after the previous birth) does not vary much among the three groups of states. High-mortality

Table 2 Characteristics of children of birth order two or higher who were born during the four years before the survey in states with low, medium, and high infant mortality, NFHS-1, 1992–93

	Infant mortality level[a]		
	High	Medium	Low
Socioeconomic background variables			
Percent rural	84	76	65
Percent whose mother is illiterate	77	65	49
Percent Hindu	82	83	72
Percent Muslim	17	14	15
Percent other religion	2	3	13
Percent scheduled caste or scheduled tribe	22	24	16
Mean standard-of-living index	3.7	4.2	5.4
Antenatal and delivery care variables			
Percent whose mother had antenatal care	30	58	71
Percent whose mother had two tetanus injections	34	63	73
Percent delivered at a medical facility	12	32	48
Demographic variables			
Percent with preceding birth interval less than 24 months	21	18	21
Mean birth order	3.3	2.7	2.5
Percent whose mother's age at childbirth was below 20	21	28	25
Percent whose mother's age at childbirth was 20-34	72	69	72
Percent whose mother's age at childbirth was 35 and above	7	4	3
Percent with an older sibling who died	30	19	15
Percent female	49	49	49

[a]See Table 1 for the three groupings of states according to infant mortality levels.

states have relatively large proportions of children from large families (high mean birth order) and of children with an older sibling who died. Slightly less than half of the children are girls, as expected.

FACTORS AFFECTING BREASTFEEDING PRACTICES

As mentioned earlier, breastfeeding is nearly universal in India, with an early introduction of supplemental food for most children and a prolonged period of nonexclusive breastfeeding (with supplements) beyond the first year of life. In this section, we examine in more detail the factors that affect breastfeeding practices at successive stages of infancy. The analysis focuses on how socioeconomic background variables, antenatal and delivery care variables, and demographic variables affect breastfeeding of infants age 2, 7, and 11 months.

Figure 1 shows distributions of children by type of breastfeeding and by age in months. Children are categorized as receiving exclusive breastfeeding, nonexclusive breastfeeding, or no breastfeeding at each month of age. Up to six months, exclusive breastfeeding is more common in the medium-mortality states than in the other states. Beyond six months, exclusive breastfeeding is most common in the high-mortality states. No breastfeeding is less common in the high-mortality states than in the other states.

The multinomial logistic regression results indicate that urban/rural residence, mother's literacy, household economic status, and whether the child was delivered in a medical facility all have substantial effects on breastfeeding practices. The other predictor variables have small effects.

Table 3 shows the adjusted proportions of children age two months who receive exclusive breastfeeding, nonexclusive breastfeeding, and no breastfeeding by urban/rural residence, mother's literacy, household economic status, and place of delivery. For each variable (urban/rural residence, for example), the effects of the other variables included in the model are controlled by setting them at their mean values (see Retherford and Choe 1993, Chapter 6, for methodology). WHO recommends that all children at age two months receive nothing but mother's milk. Table 3 shows that breastfeeding practices in India depart substantially from this recommendation. The proportion of children age two months who receive exclusive breastfeeding is low: 34 percent in the high-mortality states, 51 percent in the medium-mortality states, and 40 percent in the low-mortality states. Urban residence, mother's literacy, and high household economic status are all associated with a low proportion of children receiving exclusive breastfeeding.

The proportion of children age two months who are not breastfed at all is highest in the medium-mortality states and lowest in the high-mortality states. In the high- and medium-mortality states, two-month-old infants whose mothers are literate are less likely to be breastfed than are children of illiterate mothers.

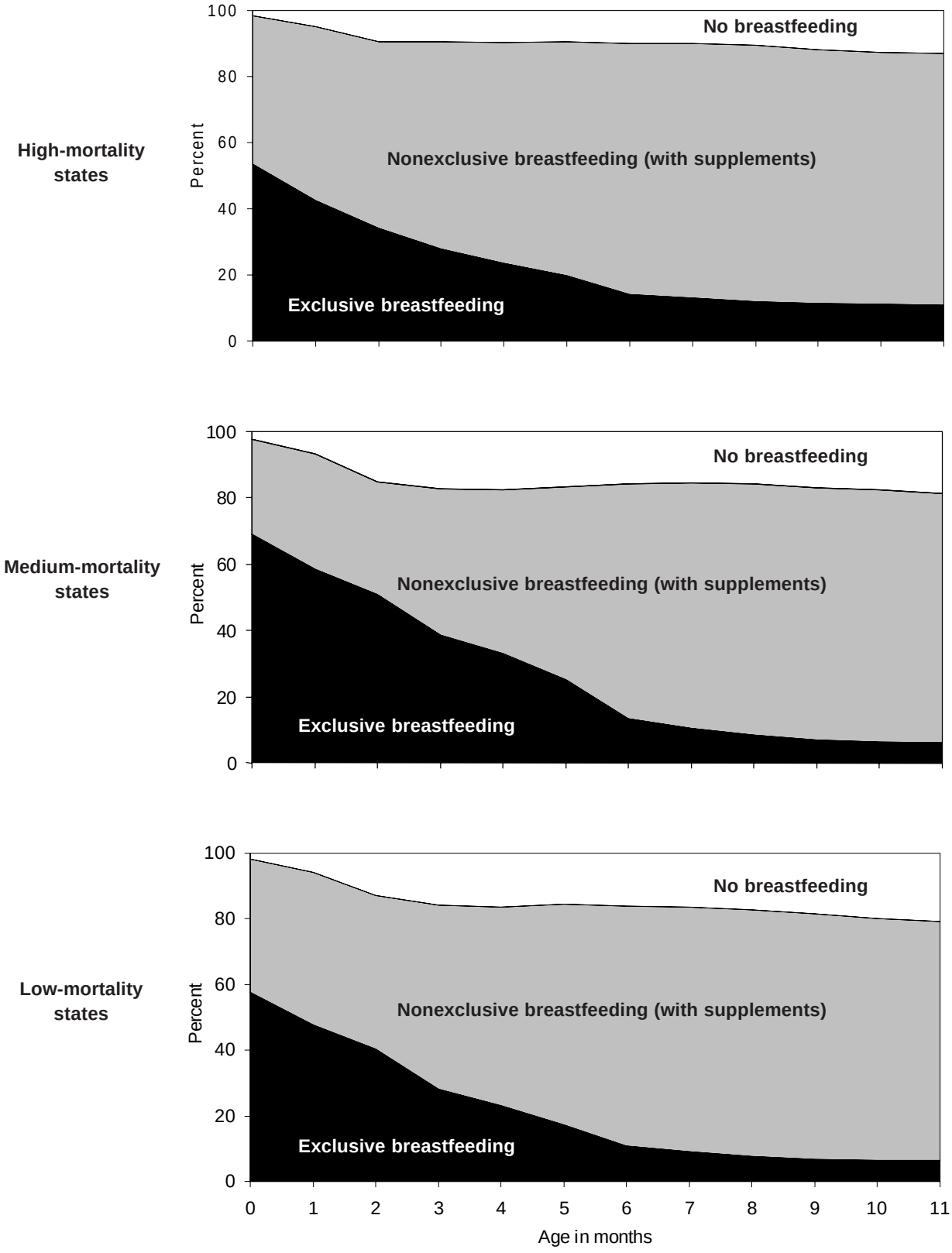

Figure 1 Distribution of children by type of breastfeeding and by age: High-mortality, medium-mortality, and low-mortality states, NFHS-1, 1992–93

Table 3 Effects of selected predictor variables on breastfeeding practices for children age two months, NFHS-1, 1992–93

Mortality level (three groups of states)	Predictor variables	Adjusted percentage of women practicing each type of breastfeeding		
		Exclusive	Nonexclusive	None†
High mortality	All	34	57	9
	Rural residence	36*	55*	9
	Urban residence†	26	66	8
	Mother illiterate	36*	56*	8
	Mother literate†	31	59	11
	Standard-of-living score = 2	37*	54*	9
	Standard-of-living score = 4	34*	57*	9
	Standard-of-living score = 6	31*	60*	9
	Born at home†	36	55	9
	Born at medical facility	24*	65	11
Medium mortality	All	51	34	15
	Rural residence	52	33*	15
	Urban residence†	45	41	14
	Mother illiterate	55*	32	13
	Mother literate†	43	39	18
	Standard-of-living score = 2	55*	30*	15
	Standard-of-living score = 4	51*	34*	15
	Standard-of-living score = 6	47*	38*	15
	Born at home†	49	37	14
	Born at medical facility	54	30*	17
Low mortality	All	40	47	12
	Rural residence	42*	46*	12
	Urban residence†	33	55	12
	Mother illiterate	42*	46	12
	Mother literate†	37	51	12
	Standard-of-living score = 2	44*	44*	12
	Standard-of-living score = 4	36*	51*	12
	Standard-of-living score = 6	30*	58*	13
	Born at home†	39	49	12
	Born at medical facility	47	38*	14

Note: Numbers in the three rows labeled 'All' are simple percentages calculated directly from the data. The remainder of the table is based on three multinomial logistic regressions, one for each of the three groups of states. The percentages shown are adjusted by multiple classification analysis (MCA) in conjunction with multinomial logistic regression, with the following predictor variables: urban residence, mother's literacy, religion of head of household (Hindu, Muslim, other), membership in a scheduled caste or scheduled tribe, standard-of-living index (0 through 27), whether the mother received any antenatal care, whether the mother received two tetanus injections during pregnancy, whether the child was delivered at a medical facility, whether the child was born less than 24 months after the previous birth, child's birth order, mother's age at childbirth (less than 20 years, 20–34 years, 35 years and above), whether the child has any older siblings who died, and child's sex. The adjusted percentages shown in the table for any given predictor variable control for the potentially confounding effects of all the other predictor variables (by setting these other predictor variables to their mean values), including all the predictor variables listed above as well as those shown in the table. In the MCA analysis, the constant terms in the underlying regressions are reset so that, when all the predictor variables are set to their mean values, the predicted (adjusted) percentages equal the simple percentages calculated directly from the data. In the table, a dagger (†) indicates a reference category and an asterisk (*) indicates that the underlying multinomial logistic regression coefficient, associated with the ratios of the probability of exclusive or nonexclusive breastfeeding to the probability of no breastfeeding, differs significantly from zero at the 5 percent level.

Table 4 Effects of selected predictor variables on breastfeeding practices for children age seven months, NFHS-1, 1992–93

Mortality level (three groups of states)	Predictor variables	Adjusted percentage of women practicing each type of breastfeeding		
		Exclusive	Nonexclusive	None†
High mortality	All	13	77	9
	Rural residence	14*	77*	9
	Urban residence†	11	78	11
	Mother illiterate	15*	77*	9
	Mother literate†	10	79	10
	Standard-of-living score = 2	15*	76*	9
	Standard-of-living score = 4	12*	79*	10
	Standard-of-living score = 6	9*	81*	11
	Born at home†	14	78	9
	Born at medical facility	12*	77*	11
Medium mortality	All	11	73	15
	Rural residence	11*	74*	15
	Urban residence†	11	72	18
	Mother illiterate	14	71	15
	Mother literate†	7	76	16
	Standard-of-living score = 2	14*	72*	14
	Standard-of-living score = 4	9*	74*	16
	Standard-of-living score = 6	6*	75*	19
	Born at home†	13	73	14
	Born at medical facility	9*	73*	18
Low mortality	All	9	75	16
	Rural residence	9	76	16
	Urban residence†	10	74	16
	Mother illiterate	13	72	15
	Mother literate†	6	77	16
	Standard-of-living score = 2	12*	74*	14
	Standard-of-living score = 4	9*	75*	16
	Standard-of-living score = 6	6*	76*	18
	Born at home†	10	76	14
	Born at medical facility	8*	74*	18

Note: See note to Table 3.

In the low- and medium-mortality states, exclusive breastfeeding is more common among children age two months who were born at medical facilities than among children born at home. This is not the case in the high-mortality states, however. It is possible that in the high-mortality states, where only a small proportion of children are born in medical facilities, a disproportionately large share of births in medical facilities are high-risk births to women who had pregnancy complications. In such cases, either the infants or their mothers are likely to be in poor health, making exclusive breastfeeding difficult.

Table 4 shows the effects of selected socioeconomic background variables and place of delivery on breastfeeding practices at age seven months. WHO recommends that children at seven months receive mother's milk as well as supplemental food in solid or mushy form. In India, breastfeeding is somewhat less common at seven

Table 5 Effects of selected predictor variables on breastfeeding practices for children age 11 months, NFHS-1, 1992–93

Mortality level (three groups of states)	Predictor variables	Adjusted percentage of women practicing each type of breastfeeding		
		Exclusive	Nonexclusive	None†
High mortality	All	11	76	13
	Rural residence	12*	76*	12
	Urban residence†	9	75	16
	Mother illiterate	12*	76*	12
	Mother literate†	8	78	14
	Standard-of-living score = 2	13*	75*	12
	Standard-of-living score = 4	9*	77*	14
	Standard-of-living score = 6	6*	78*	16
	Born at home†	12	76	12
	Born at medical facility	6*	78	16
Medium mortality	All	6	75	19
	Rural residence	6*	76*	18
	Urban residence†	5	72	23
	Mother illiterate	8*	74	18
	Mother literate†	4	76	20
	Standard-of-living score = 2	7*	75*	17
	Standard-of-living score = 4	5*	75*	20
	Standard-of-living score = 6	4*	73*	23
	Born at home†	7	76	17
	Born at medical facility	5*	72*	23
Low mortality	All	7	73	21
	Rural residence	7	74*	20
	Urban residence†	7	71	22
	Mother illiterate	11	70	19
	Mother literate†	4	74	22
	Standard-of-living score = 2	10*	73*	18
	Standard-of-living score = 4	6*	73*	21
	Standard-of-living score = 6	4*	72*	24
	Born at home†	7	24	18
	Born at medical facility	6*	71*	23

Note: See note to Table 3.

months than at two months. About three-fourths of children in this age group are fed according to WHO recommendations. In all three groups of states, a substantial proportion of children who live in rural areas, whose mothers are illiterate, and whose families are of low economic status receive exclusive breastfeeding without supplementation. A particularly large proportion of children who live in low-mortality states, who live in urban areas, and whose families have high economic status are not breastfed at all.

By 11 months of age, 13 percent of children in the high-mortality states, 9 percent in the medium-mortality states, and 21 percent in the low-mortality states are not breastfed (Table 5). A substantial proportion of children who live in rural areas, whose mothers are illiterate, and whose families have low economic status still receive exclusive breastfeeding at this age without supplementation. This pattern, which

is especially pronounced in the high-mortality states, suggests that feeding supplemental food depends in part on whether the family can afford the supplements.

EFFECTS OF BREASTFEEDING ON POSTNEONATAL MORTALITY

The effects of exclusive and nonexclusive breastfeeding on mortality at ages 1–11 months are estimated applying logistic regression models to NFHS-1 data. Odds ratios, which are our preferred measure of effect, are calculated as exponentials of the estimated logistic regression coefficients. They indicate the multiplicative effect of exclusive or nonexclusive breastfeeding, relative to no breastfeeding, on the odds of dying. An odds ratio equal to one indicates that the breastfeeding practice has no effect on mortality during the three-month period following the specified month of age, an odds ratio less than one indicates that the breastfeeding practice lowers mortality, and an odds ratio greater than one indicates that the practice raises mortality.

Table 6 shows the estimated logistic regression coefficients, representing the effects of exclusive and nonexclusive breastfeeding on the log-odds of dying during the three-month period following each specified month of age, ranging from 0 to 11 months. Figure 2 also shows these effects in terms of odds ratios. In the figure, the odds ratios for no breastfeeding are uniformly equal to one because this is the reference category, so the ratios simply compare the 'no breastfeeding' category with itself.

In all three groups of states, both exclusive and nonexclusive breastfeeding lower mortality during the first months of infancy, as shown by the negative numbers in the table. Exclusive breastfeeding is associated with increased mortality for older infants, however. This is not surprising because children's nutritional needs are not met completely by mother's milk after the first few months of infancy. The effect of exclusive and nonexclusive breastfeeding on mortality at ages 3–6 months varies at different levels of mortality. In the high-mortality states, mortality levels are similar for children who are breastfed with supplements and for children who are not breastfed at all, and mortality is higher for children who are breastfed exclusively. In the medium-mortality states, by contrast, both exclusive and nonexclusive breastfeeding lower mortality, but nonexclusive breastfeeding tends to have a larger effect. In low-mortality states, breastfeeding with supplements lowers mortality, while exclusive breastfeeding has no effect.

In summary, breastfeeding has a smaller beneficial effect on child survival in states where infant mortality is high than in other states. In high-mortality states, exclusive breastfeeding does not lower mortality as much as breastfeeding with supplements, even for children at very young ages. For children age two months and above, exclusive breastfeeding tends to increase mortality. Results in the medium-mortality states are more consistent with earlier studies, but the benefits of exclusive

Table 6 Estimated logistic regression coefficients of exclusive and nonexclusive breastfeeding at each month of infancy on mortality during the next three months in three groups of states classified according to infant mortality levels

Type of breastfeeding and month of age	Months of mortality exposure	Logistic regression coefficient of breastfeeding variable		
		High-mortality states	Medium-mortality states	Low-mortality states
Exclusive breastfeeding				
0	1–3	–1.6087*	–1.7903*	–1.4415*
1	2–4	–0.7417*	–1.1910*	–0.6886
2	3–5	0.0750	–0.5116	–0.2531
3	4–6	1.2367*	–0.4828	0.3023
4	5–7	1.4938*	–0.6857	0.3229
5	6–8	1.2637*	–0.9469*	0.4079
6	7–9	1.6988*	–0.2622	0.7318
7	8–10	2.4678*	0.2613	0.9461
8	9–11	2.7104*	0.7886	1.7930*
9	10–12	2.5056*	1.3139*	2.3820*
10	11–13	2.2324*	1.7725*	2.5015*
11	12–14	2.1022*	2.2462*	2.5496*
Nonexclusive breastfeeding				
0	1–3	–2.7743*	–1.8590*	–2.3649*
1	2–4	–2.0642*	–1.2112*	–1.3521*
2	3–5	–1.2970*	–0.6758	–0.9878*
3	4–6	–0.2776	–0.8226*	–0.9703*
4	5–7	–0.2082	–1.1752*	–1.2059*
5	6–8	–0.3406	–1.1571*	–1.0792*
6	7–9	0.1043	–0.8983*	–0.8553*
7	8–10	0.1621	–0.7079	–0.9536*
8	9–11	0.0466	–0.5667	–0.8392*
9	10–12	–0.0954	–0.4869	–0.7257*
10	11–13	–0.1644	–0.2305	–0.7650
11	12–14	0.1292	0.3050	–0.3708

Note: Coefficients are estimated from 36 separate logistic regression models, one for each specified month of infancy in each of the three groups of states. Predictor variables in the logistic regression models, in addition to dummy variables for exclusive breastfeeding and nonexclusive breastfeeding, are urban residence, mother's literacy, religion of head of household (Hindu, Muslim, other), membership in a scheduled caste or scheduled, standard-of-living index (0 through 27), whether the mother received any antenatal care, whether the mother received two tetanus injections during pregnancy, whether the child was delivered at a medical facility, whether the child was born less than 24 months after a previous birth, mother's age at childbirth (less than 20 years, 20–34 years, 35 years and above), whether the child has any older siblings who died, and child's sex. The coefficients shown in the table for exclusive and nonexclusive breastfeeding control for all of the other predictor variables listed above. An asterisk indicates that the underlying logistic regression coefficient differs significantly from zero at the 5 percent level.

breastfeeding are less than others have noted. In low-mortality states, breastfeeding with supplements has the most beneficial effect on child survival.

Two explanations for these findings are plausible. First, it may be that the supplemental food given to very young children in India tends to be hygienic and of good quality. Information in the national NFHS-1 report supports this hypothesis (IIPS 1995, p. 275). The most common form of supplemental food for children less than four months old is water and other types of milk, and mothers rarely use bottles with

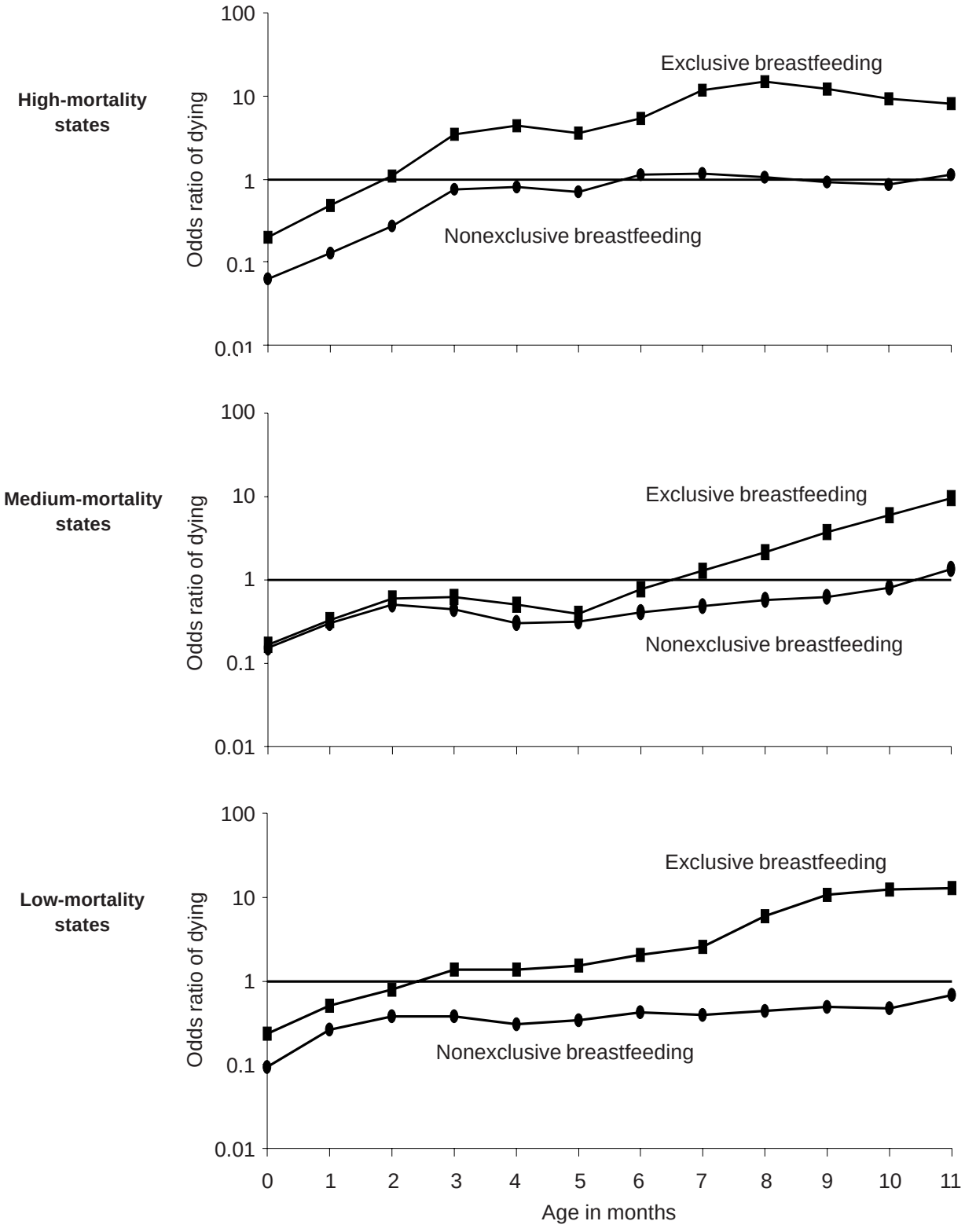

Figure 2 The effects of exclusive and nonexclusive breastfeeding on postneonatal mortality, compared with no breastfeeding (odds ratio = one), in high-mortality, medium-mortality, and low-mortality states: NFHS-1, 1992–93

nipples (which are often a source of infection because of inadequate sterilization). Second, some mothers may have inadequate breast milk, especially in the high-mortality states, due to their own poor nutrition and health status, early childbearing, and high fertility. We have seen earlier that exclusive breastfeeding is more common among women who live in rural areas, women who are illiterate, and women whose households have low economic status than among other women. This suggests that women who practice exclusive breastfeeding may be more likely than other women to produce inadequate breast milk.

It is likely that the effects of breast milk and of supplementary food have different levels of influence in the three groups of states. In both high-mortality and low-mortality states, the combination of breast milk with supplemental feeding is associated with the lowest level of infant mortality at most ages, but the reasons for this pattern may be different in the two groups of states. In the high-mortality states, mother's milk may be inadequate even for very young infants (three months), and the risks associated with supplemental feeding may be less than the benefits of supplementing inadequate breast milk. In the low-mortality states, it is unlikely that mother's milk is inadequate for infant feeding, but breastfeeding with supplementation may be associated with lower mortality than exclusive breastfeeding because the quality of supplements tends to be high. In the medium-mortality states, mother's milk seems to be adequate until about six months, and supplemental food, when given, does not seem to pose any additional risks for most infants.

At the same time, problems with data quality cannot be ruled out. It is possible that in the high-mortality states there is a greater tendency than in the medium-mortality states for mothers not to provide information on children who were too sick to breastfeed and who died at very young ages. Such selective omission of children from mothers' birth histories would result in an underestimation of the effect of breastfeeding on mortality.

This analysis shows that in India the benefits of exclusive breastfeeding are limited to the first few months of infancy. In high-mortality states, exclusive breastfeeding is associated with higher mortality than either nonexclusive breastfeeding or no breastfeeding from three months of age. It appears that the benefits of breastfeeding are considerably reduced when the mother is poorly nourished and in poor health. Overall, the analysis shows that breastfeeding with supplementation is the most beneficial type of feeding for infant survival, even at very young ages.

DISCUSSION

It has been suggested that in traditional Indian society prolonged breastfeeding is a cheap source of food for children (Nath, Land, and Singh 1994), which is an important consideration in poor families. NFHS-1 data support this argument. In states

where infant mortality is high and households have low economic status, the introduction of supplemental food is late, and the nutritional content of supplemental food appears to be poor.

This analysis supports the hypothesis that breastfeeding reduces mortality throughout the first year of life, especially when combined with supplemental food introduced at appropriate ages. At the same time, the results indicate that the effect of breastfeeding in lowering infant mortality is smaller the higher the level of mortality. The beneficial effects of both exclusive and nonexclusive breastfeeding are weakest in states where infant mortality is high and strongest in the medium-mortality states. It appears that mother's breast milk is more likely to be inadequate in states with high infant mortality than elsewhere in India.

The most surprising finding of this study is that in most of the cases examined nonexclusive breastfeeding is more beneficial than exclusive breastfeeding, even for children at very young ages (below four months) when exclusive breastfeeding is typically recommended. Thus, it may be possible to reduce infant mortality in India by encouraging breastfeeding throughout the first year of life together with the introduction of nutritious supplemental food as early as 2–3 months after birth. Educational programmes encouraging these practices should be implemented in combination with programmes that make appropriate supplemental foods for infant feeding available to poor families.

The findings also suggest that it is important for breastfeeding mothers to have good health and to eat well themselves if their children are to benefit fully from breastfeeding. Therefore, supplementary food programmes for infants should also provide nutritious foods to pregnant and lactating women in poor families.

The results in this report call into question the WHO recommendation that children be exclusively breastfed up to age 4–6 months. The findings indicate that supplemental food should be introduced at earlier ages, especially when a mother's health and nutritional status are low. In such situations, it appears that mother's milk is frequently not adequate to provide the level of nutrition that a growing infant requires. It also appears that the dangers of disease contamination from supplemental foods may not be as great as commonly thought, at least not in India. Further research is needed to explore the relationship between the nutrition and health of mothers and the effects of breastfeeding on infant mortality in developing countries.

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