Impact of Clean Cord Care Practices on Neonatal Mortality: Evidence from rural Uttar Pradesh, India

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Abstract

Objective: About 1.2 million newborns die each year in India alone, accounting for about one-fourth of total global neonatal deaths. Care practices immediately following delivery contribute to newborns' risk of morbidity and mortality. Clean cord care, thermal care and breastfeeding have been identified as proven interventions that save newborn lives. The purpose of this paper is to examine the impact of clean cord care practice on neonatal mortality in rural Uttar Pradesh.

Methodology: The study was conducted in Barabanki district of Uttar Pradesh. Data were collected on newborn care practice including clean cord care practices and neonatal mortality as part of evaluation of a community based intervention. This paper presents data from 7,812 women who gave birth to a singleton live baby at home in the calendar years 2004-2005 (institutional births, stillbirths and multiple births were excluded from this analysis). The components of clean cord care practice which is considered here are clean instrument used to cut cord, clean thread used to tie cord and nothing applied to cord. Standard descriptive analysis was conducted. Chi-square tests were performed to compare the significant differentials. The impact of clean cord care practices on neonatal mortality were estimated using multiple logistic regression, after adjusting for mother's age, education, caste/tribe, religion, and wealth quintile and ANC care. Data analysis was conducted with Stata/SE 8.

Main findings: Abut 30 percent of the study mothers practiced clean cord care. A significant variation was observed in the cord care practice according to program exposure and background characteristics. Unadjusted logistic regression result shows that clean cord care practice was associated with 38 percent lower neonatal mortality (OR= 0.62; 95% CI: 0.48-0.79). The association remained unchanged and statistically significant (OR=0.61; 95% CI: 0.48-0.78).) even when the effects of other selected socio-economic and demographic risk factors and potential confounders such as ANC were controlled. Promoting clean cord care practice among the neonates in community-based maternal and newborn care programs can be an effective tool for decreasing the neonatal

mortality rate in India.

Introduction

Infant and child mortality rates reflect a country's level of socio-economic development and quality of life and are used for monitoring and evaluating population and health programs and policies. Although infant mortality has fallen in many developing countries over the past two decades, the rate of fall is much slowing (United Nations Children's Fund, 1999). One reason is the defiant contribution of neonatal mortality, which has remained fairly steady over this period (Claeson et al. 2000; Bhave, 1989). About two-thirds of all infant deaths and 38% of all under-five deaths occur during the neonatal period, resulting in about 4 million neonatal deaths globally per year (Lawn et al 2005; Lawn et al., 2004; WHO 2003; SNL, 2001). Neonatal deaths in India exceed one million annually, with over 25 percent occurring in Uttar Pradesh, the most populous state. For many mothers, health care during and after childbirth is virtually non-existent, and in 2000, an estimated 53 million women in developing countries gave birth without professional help (United Nations Fund for Population Activities, 2000). More than 80 percent of infant deliveries take place at home, where women are out of reach of the formal health care system. As a consequence, most of the newborn deaths happen in the home.

The World Health Organization guidelines for essential newborn care encompass cleanliness, thermal protection, initiation of breathing, early and exclusive breast feeding, eye care, immunisation, management of illness, and the care of low birth weight infants (WHO, 1996). For a mother and her family, this means preparing for birth, choosing a safe place for delivery, keeping the process clean, avoiding the cold, breast feeding early and exclusively, and understanding (and reacting to) potential danger signs. Our understanding of what happens at home and how to change behaviour is limited. Tetanus and infections are among the leading causes of neonatal mortality. Each year some 500000 infants die of neonatal tetanus and a further 460000 die as a consequence of severe bacterial infection. A substantial proportion of deaths from infection are due to cord infections. Infants with neonatal tetanus often have a concomitant cord infection, which points to a common cause (i.e. unclean delivery and cord care practices). Strategies to reduce the risk of neonatal tetanus and cord infections include promoting clean delivery and clean cord care and increasing tetanus toxoid immunization coverage in women of reproductive age.

Neonatal tetanus and cord infections continue to be an important cause of neonatal morbidity and mortality in developing countries. A number of factors contribute to the high incidence of tetanus and infection in these countries: most deliveries take place at home, often in unhygienic circumstances, deliveries are conducted by untrained birth attendants, and some traditional cord care practices are harmful. Infections are not the only concern. Bleeding from the cord stump - although more rare than infection - can rapidly be fatal. Bleeding can, however, be effectively prevented by tight tying or clamping and by prevention of infection.

Cord care is thus an important issue that needs to be addressed. As in the case of research into other aspects of pregnancy and delivery care, research on cord care has focused more often on

interventions such as early cord clamping and the use of topical antimicrobials on the stump and much less on practices that are based on 'natural' or physiological processes. Cost is another aspect of cord care. In countries where mothers receive postnatal visits, problems with the cord often determine the number of visits. If cord separation and healing are delayed, as when some antimicrobials are used, the cost of postnatal care may unnecessarily increase (Mugford et al, 1986).

There is evidence that cord infections are common in developing countries. One hospital study found that, in 47% of infants hospitalized with sepsis, cord infection was the source of the illness, and that 21% of infants admitted for other reasons had omphalitis (cord infection) (Faridi, et al, 1993). Two third of the babies in our country are born at home and are at a higher risk of developing sepsis. A prospective study in urban slums found an incidence for umbilical sepsis of 30/1000 (Singhal, et al, 1990). Babies born in hospital may also develop infection at home after discharge from the hospital. Low birth weight babies and preterm babies are at a higher risk of developing infection.

The commonest sources of cord infection in India are unhygienic practices during delivery at home which include delivery in dark dirty rooms, cord cut with any available sharp instrument and the baby wrapped in old, dirty clothes. Other practices that increase the risk of infection include harmful applications to the cord, discarding colostrum and use of prelacteal feeds. Numerous visitors, who could be carriers of infection, are another source of infection for the babies. Two thirds of the deliveries in our country take place at home. Unhygienic practices at birth are also responsible for infections and deaths both of the baby and mother. The umbilicus could be the entry point for life threatening infections like tetanus, meningitis and septicemia. Cord infection can be reduced by clean cord care and reducing harmful applications to the cord: The simplest way of caring for the cord is to keep it clean, avoid any form of application and leaving it open to dry.

About two-thirds of births in developing countries take place outside health facilities and almost half of the women are delivered by untrained traditional birth attendants, family members or deliver on their own. A wide variety of traditional practices and beliefs are associated with care of the umbilical cord. Traditional beliefs must be taken into account when introducing clean cord care programmes in a community since these beliefs may conflict with programme recommendations. Some traditional practices such as applying unclean substances to the cord are dangerous and should be discouraged or replaced with safer alternatives. Practices will not change unless people are convinced that the new practice is indeed better. Some traditional practices are beneficial and should be promoted, while others may be ignored.

Most neonatal deaths in developing countries occur at home, unattended by skilled health professionals (Lawn et al., 2004; WHO, 2003). In India, 65.4% of all births and 75.3% of births in rural areas occur at home (Lawn et al., 2004). Therefore, understanding routine newborn care practices in the home is necessary in order to design and prioritize interventions to reduce neonatal morbidity and mortality.

In the above perspective, the purpose of this paper is to examine the impact of clean cord care practice on neonatal mortality in rural Uttar Pradesh and to examine the association of selected socio-demographic, antenatal and delivery care factors with this practice.

Material and Methods

The study was conducted in rural blocks of Barabanki district of Uttar Pradesh. According to National Family Health Survey (NFHS) of India, the total fertility rate in Uttar Pradesh (UP) state was 3.99, and the neonatal mortality rate in rural UP was 56.6 per 1000 live births (IIPS and ORC Macro 2001). The neonatal mortality rate in the study area during 2001-2002 was 49 per 1000 live births (Baqui et al., 2006).

Data used in this study were collected on newborn care practice including clean cord care practices and neonatal mortality by the Department of International Health, Johns Hopkins Bloomberg School of Public Health (JHSPH), Baltimore, USA in collaboration with the King George Medical University, Lucknow, India. This is an endline data colleted during January - March 2005 for evaluation of a community based intervention program of CARE-India. Within the district, 8 rural blocks were randomly selected and then 1 sector was randomly selected from each block. Mapping and listing exercises were done and personal interview was conducted to identify women that had a livebirth or stillbirth during the two years preceding the survey, referred to as recently delivered women (RDW). RDW were asked detailed questions about the care they received during pregnancy and delivery, their newborn care practices in the home and socio-demographic factors. This paper presents data from 7,812 women who gave birth to a singleton live baby at home in the calendar years 2004-2005 (institutional births, stillbirths and multiple births were excluded from this analysis).

RDW were asked about essential newborn care practices, including: (a) what type of instrument was used to cut the umbilical cord and whether the instrument had first been sterilized by boiling; (b) what type of material was used to tie the cord stump and whether this material had been sterilized by boiling (SNL, 2001). The components of clean cord care practice which is considered here are clean instrument used to cut cord, clean thread used to tie cord and nothing applied to cord.

Independent data quality assurance was conducted on 5% of the sample households. Data were entered twice by independent data operators, then matched and checked for internal consistency. The study received ethical approval from the Johns Hopkins University Committee on Human Research and the King George Medical University ethics committee.

Standard descriptive analysis was conducted. Clean cord care practice was coded as binary outcome and used as dependent variables: clean cord care (use of both a clean cutting instrument to cut the umbilical cord and a clean thread to tie it and nothing applied after cutting). Explanatory variables included: maternal age category, maternal education level, household wealth index, religion, and some program exposure variables. Chi-square tests were performed to compare the levels of clean cord care practices within the socio-economic and demographic and antenatal care variables. A multiple logistic regression model was constructed using all of the explanatory variables. The impact of clean cord care practices on neonatal mortality were estimated using multiple logistic regression, after adjusting for mother's age, education, caste/tribe, religion, and wealth quintile and ANC care. Data analysis was conducted with Stata/SE 8 (Statacorp, 2003).

Results

The components of clean cord care practices among recently delivered women are presented in Table 1. The components of clean cord care considered for analysis are clean instrument to cut cord, clean thread used to tie cord and anything applied to the cord. Independently, the use of clean instrument to cut the cord, clean thread to tie the cord and application of nothing on cord after cutting has been found quite better (more than 50%). However, when we see the above components in totality, the clean cord care substantially gets reduced. Clean cord care is practiced only by 30 percent of the study women.

< Table 1 about here>

Table 2 presents maternal characteristics, household characteristics and program exposure of recently delivered women who practiced clean cord care vs. those who did not. A significant differential is observed in the cord care practice according to program exposure and background characteristics. Muslims women and women belonging to scheduled caste and schedule tribes are practicing more clean cord care than their counterparts. It is also found that women who received complete ANC, took adequate dose of IFA tablets and received two or more dose of TT injections during their pregnancy are practicing more clean cord care than who did not.

< Table 2 about here>

Table 3 presents unadjusted and adjusted logistic regression results in terms of odds ratios (OR) and 95% confidence intervals (CI). Unadjusted logistic regression result shows that clean cord care practice was associated with 38 percent lower neonatal mortality (OR= 0.62; 95% CI: 0.48-0.79). The association remained unchanged and statistically significant (OR=0.61; 95% CI: 0.48-0.78) even when the effects of other selected socio-economic and demographic risk factors and potential confounders such as ANC were controlled in another model. Interestingly, none of the socio-economic and demographic factors or potential confounders have shown significant effect on the neonatal mortality in the adjusted model.

< Table 3 about here>

Discussion

This study has described one of the important essential newborn care practice i.e. clean cord care and its impacts on neonatal mortality in a large rural community of Uttar Pradesh. Cord care practice in this setting had not been described previously through use of a community-based intervention program's independent evaluation by a large survey. Although these findings are similar to studies from other settings, some variations were observed.

Abut 30 percent of the study mothers practiced clean cord care. A significant variation was observed in the cord care practice according to program exposure and background characteristics. In this study, most women reported that the instrument used to cut the umbilical cord was sterilized, but sterilizing the cord tie was practiced less widely, so that in combination only 30% of women reported clean cord care. Moreover, the survey did not enquire how long the

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blade or thread were boiled; boiling may have been insufficient or items may have been re-contaminated before being used, so this figure may overestimate the prevalence of effective clean cord care. Cord cutting and tying practices have been identified as risk factors for neonatal infection (Darmstadt et al., 2005; Moss et al., 2002; Bhutta, 2000; WHO, 1998; Bhutta et al., 1998) and studies suggest low coverage of clean cord care practices among home deliveries in South Asia (Manandhar et al., 2004; Osrin et al., 2002; Nandan & Mishra, 1996). Review studies have noted the lack of cost-effectiveness studies for strategies to improve clean delivery practices, including training of traditional birth attendants (Bhutta, 2005; Sibley & Ann Sipe, 2004). The findings presented here suggest that home visits by frontline health workers (ANMs and *Anganwadi* workers) and other forms of antenatal counseling may improve clean delivery practices which can help in reducing neonatal mortality. The cost-effectiveness of this strategy should be examined. Scaling up the use of clean delivery kits should be also explored in this area, although counseling on the use of kit contents is also essential (Bhutta et al., 2005).

Some limitations are inherent to a cross-sectional survey of this type that involves reporting of past behaviors. The study was conducted among a largely illiterate population, and this may have hindered the respondents' ability to report some types of information accurately. A two-year recall period was chosen to minimize recall bias, while allowing for sufficient sample size. Rigorous methods were employed to maintain data quality.

Another limitation of the present study is that it examined three behaviors that are primary prevention strategies. However, recent studies suggest that postnatal, secondary preventive behaviors - including timely care-seeking and prompt antibiotic treatment for infections - may be among the most efficacious and cost-effective strategies for reducing neonatal mortality (Darmstadt et al., 2005; Bhutta et al., 2005; Bang et al., 2005; Bang et al., 2005).

Study suggests that most neonatal deaths in India and other developing countries are preventable through interventions that have been proven efficacious (Darmstadt et al., 2005; Bhutta et al., 2005; Jones et al., 2003). The challenge is to develop appropriate strategies to ensure that clean cord care practice reach wider segments of the population (Knippenberg et al., 2005). Coverage of outreach by frontline health workers, use of antenatal care services and skilled birth attendance were low, a situation that has been described previously in Uttar Pradesh (IIPS & ORC Macro, 2001; Pallikadavath et al., 2004; Ramarao et al., 2001; Bloom et al., 1999).

Previous community-based trials to promote clean cord care as one of the essential newborn care suggested that newborn care practices might be improved through appropriate behavior change interventions (Darmstadt et al., 2005; Manandhar et al., 2004; .Bang et al, 1999). Bang et al demonstrated dramatic success in reducing neonatal morbidity and mortality through home-based care delivered by village health workers (Bang et al., 2005; Bang et al., 2005; Bang et al., 1999). Our study strongly suggests that promoting clean cord care practice among the neonates in community-based maternal and newborn care programs can be an effective tool for decreasing the neonatal mortality rate in India. There is an urgent need to educate mothers and frontline health workers (traditional birth attendants, ANMs and *Anganwadi* workers) on essential newborn care such as clean cord care. Prevailing unhealthy practices in the area also should be discussed with health care providers including dais and local practitioners, so that they take special action in preventing these. Various behavioral change communication strategies through

mass media and interpersonal education during antenatal visits could be an effective ways for promoting essential newborn care practices to decrease neonatal mortality in rural India.

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Table 1: Components of clean cord care practices among recently delivered women

Components of cord care practices	Number of women	Percent
Clean instrument used to cut cord		
No	1,359	17.4
Yes	6,453	82.6
Clean thread used to tie cord		
No	3,316	42.4
Yes	4,496	57.6
Both clean instrument and clean thread used		
No	3,323	42.5
Yes	4,489	57.5
Anything applied to cord		
No	3,163	48.6
Yes	3,054	47.0
DK	284	4.4
Clean cord care practice[1]		
No	5,493	70.3
Yes	2,319	29.7
Total	**7,812**	**100.0**

[1] Clean instrument and clean thread used and applied nothing to cord

Table 2: Characteristics of recently delivered women who practiced clean cord care vs. those who did not

	Number of women	Did not Practice Clean Cord Care	Practiced Clean Cord Care	Chi-square p-value
Maternal Characteristics				
Age at Most Recent Birth				<0.545
<20	1,367	71.5	28.5	
20-34	4,435	70.1	29.9	
>=35	2,010	70.0	30.1	
Education Level				<0.007
Illiterate	5,845	69.5	30.5	
Literate, < middle school completed	991	73.5	26.5	
Middle School completed	608	70.1	29.9	
High School completed and above	368	75.8	24.2	
Household Characteristics				
Caste/tribe				<0.001
Scheduled caste/ Scheduled tribe	3,166	68.2	31.8	
Other backward class	3,723	70.8	29.2	
Others	917	75.6	24.4	
Religion				<0.001
Hindu	6,265	71.4	28.6	
Muslim/other	1,547	66.1	33.9	
Wealth Quintile				<0.142
Poorest	2,003	69.3	30.7	
2nd	1,008	68.7	31.4	
3rd	1,566	70.5	29.5	
4th	1,706	70.1	29.9	
Least Poor	1,529	72.8	27.2	
Program exposure				
				<0.001
TT injection				
None	1,724	79.6	20.4	
One	593	72.9	27.2	
Two or more	5,495	67.1	32.9	
				<0.001
Iron folic acid tablet intake				
None	2,280	81.3	18.7	
Inadequate <100 tablets	3,869	71.2	28.8	
Adequate >=100 tablets	1,663	53.3	46.7	
Complete ANC				<0.001
No	6,860	72.1	27.9	
Yes	952	57.3	42.8	
Total	**7,812**	**5,493 (70.3%)**	**2,319 (29.7%)**	

Numbers in table are row percentages unless otherwise stated.

Table 3: Unadjusted and Adjusted effect of clean cord care on neonatal mortality by logistic regression

Predictors	Unadjusted		Adjusted Model	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Clean cord care				
No	1.00		1.00	
Yes	0.62	[0.48, 0.79]	0.61	[0.48, 0.78]
Complete ANC				
No	1.00		1.00	
Yes	0.93	[0.67, 1.27]	1.06	[0.77, 1.47]
Other Covariates				
Age at Most Recent Birth				
<20	1.00	--	1.00	--
20-34	0.77	[0.59, 1.00]	0.79	[0.60, 1.03]
>=35	0.90	[0.67, 1.21]	0.91	[0.67, 1.23]
Education Level				
Illiterate	1.00	--	1.00	--
Literate, < middle school completed	1.07	[0.79, 1.44]	1.10	[0.81, 1.51]
Middle School completed	0.93	[0.63, 1.37]	1.00	[0.66, 1.52]
High School completed and above	0.63	[0.35, 1.12]	0.71	[0.38, 1.33]
Caste/tribe				
Scheduled caste/ Scheduled tribe	1.00	--	1.00	--
Other backward class	1.04	[0.84, 1.29]	1.06	[0.84, 1.33]
Others	0.71	[0.49, 1.04]	0.74	[0.50, 1.11]
Religion				
Hindu	1.00	--	1.00	--
Muslim/other	0.97	[0.75, 1.25]	0.99	[0.75, 1.31]
Wealth Quintile				
Poorest	1.00	--	1.00	--
2nd	0.76	[0.53, 1.09]	0.76	[0.53, 1.09]
3rd	0.90	[0.67, 1.21]	0.89	[0.66, 1.20]
4th	0.91	[0.68, 1.21]	0.90	[0.67, 1.21]
Least Poor	0.79	[0.58, 1.08]	0.84	[0.60, 1.17]

* p<0.05; ** p<0.01; *** p<0.001
Model 1 includes cord care, age, education, caste, religion, and wealth.
Model 2 includes cord care, complete ANC, age, education, caste, religion, and wealth.

Figure 1: K-M curve showing the neonatal mortality according to clean cord care (0=No; 1=Yes)

Kaplan-Meier failure estimates, by sterilecord2