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Original Research Article

Causes of stillbirths and neonatal deaths in Dhanusha district, Nepal: A verbal autopsy study

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Abstract

Background: Perinatal (stillbirths and first week neonatal deaths) and neonatal (deaths in the first 4 weeks) mortality rates remain high in developing countries like Nepal. As most births and deaths occur in the community, an option to ascertain causes of death is to conduct verbal autopsy.

Objective: The objective of this study was to classify and review the causes of stillbirths and neonatal deaths in Dhanusha district, Nepal.

Materials and Methods: Births and neonatal deaths were identified prospectively in 60 village development committees of Dhanusha district. Families were interviewed at six weeks after delivery, using a structured questionnaire. Cause of death was assigned independently by two pediatricians according to a predefined algorithm; disagreement was resolved in discussion with a consultant neonatologist.

Results: There were 25,982 deliveries in the 2 years from September 2006 to August 2008. Verbal autopsies were available for 601/813 stillbirths and 671/954 neonatal deaths. The perinatal mortality rate was 60 per 1000 births and the neonatal mortality rate 38 per 1000 live births. 84% of stillbirths were fresh and obstetric complications were the leading cause (67%). The three leading causes of neonatal death were birth asphyxia (37%), severe infection (30%) and prematurity or low birth weight (15%). Most infants were delivered at home (65%), 28% by relatives. Half of women received an injection (presumably an oxytocic) during home delivery to augment labour. Description of symptoms commensurate with birth asphyxia was commoner in the group of infants who died (41%) than in the surviving group (14%).

Conclusion: The current high rates of stillbirth and neonatal death in Dhanusha suggest that the quality of care provided during pregnancy and delivery remains sub-optimal. The high rates of stillbirth and asphyxial mortality imply that, while efforts to improve hygiene need to continue, intrapartum care is a priority. A second area for consideration is the need to reduce the uncontrolled use of oxytocic for augmentation of labour.

Key words: Stillbirth, neonatal death, verbal autopsy, Nepal.

Stillbirths and neonatal deaths remain common in many low-income countries. Nepal's most recent estimates of perinatal mortality rate (PMR: stillbirths and first week deaths) and neonatal mortality rate (NMR: deaths in the first four weeks) are 45 per 1000 births and 33 per 1000 live births, respectively[1]. About 80% of deliveries in Nepal occur at home and only 19% are conducted by health personnel[1]. Over the last 15 years, Nepal's infant mortality rate (IMR: deaths in the first year) has fallen from 82 to 48 per 1000 live births[1]. This is at least partly due to programmes conducted through government and other organizations, including those for acute respiratory infections and diarrhoeal diseases. There were no such programmes to reduce perinatal and neonatal deaths in Nepal, and their share of the overall figures has increased. If we are to reduce stillbirths and neonatal deaths, we need to know their causes. However, clinical registration of cause of death is available for less than a third of global newborn deaths[2]. When families do not seek hospital care and medical records are unavailable, trying to understand the cause of death from their accounts of illness is the only option. Verbal autopsy is a method of ascribing causes of death on the basis of information on events, signs and symptoms supplied by the deceased's caretakers[3,4,5]. Procedures for infant and child deaths have developed over the last twenty years,[6,7,8,9,10,11,12] and verbal autopsy has been used in studies,[13,14,15] in sample registration systems in India, and as part of the INDEPTH network of demographic surveillance sites[16].

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Because there is no gold standard with which to compare the findings, misclassification of causes of death is possible[17]. Occasionally, medical records are available and a process of triangulation can take place; or interviews with families whose children died in hospital can be compared with case notes and hospital records, even though the case-mix seen in hospitals is likely to differ from the pattern of illness in communities. There are several possible approaches to data collection. An interviewer (often with a non-medical background) may discuss the events that preceded death with a child's mother or family and record the narrative in open-ended form. Alternatively, a series of closed questions may be asked, designed to establish the presence or absence of particular signs and symptoms, or particular health care actions[18,19]. At the analytical stage, the narrative or closed questions are read and classified by a clinician. The development of algorithms to aid this process has led to the idea of using computer analysis to classify cause of death, but this is not yet routine[20, 21].

Mother and Infant Research Activities (MIRA) is a non-government organisation (NGO) established to improve the health of mothers and newborn infants through research, training and advocacy. MIRA has conducted several community-based studies, including a trial of community mobilisation through women's groups in Makwanpur district, which showed a 30% reduction in neonatal mortality[22]. A similar study, with some modifications, is being conducted in Dhanusha district in the southern plains of Nepal. In the course of the study, stillbirths and neonatal deaths were identified in a surveillance population of around 420 000 and 1272 verbal autopsies were collected from 60 village development committees[24]. The objective of this analysis was to classify and review the causes of stillbirths and neonatal deaths in the study area.

Materials and methods

Setting

Dhanusha is situated in the south-eastern region of Nepal and covers an area of 1180 km^2 with a population of around 777 000[23]. In a study population of around 420 000, there are approximately 55 800 married women of reproductive age and around 14 000 annual births[24]. The literacy rate is 56% and 89% of people live in rural areas[23]. The district's PMR is 63 per 1000 births and it's NMR 34 per 1000 live births[24].

Procedures

This was a prospective study that formed part of a major child survival study using women's groups to improve maternal and newborn health. Out of 101 village development committees (VDCs) in Dhanusha, after exclusion of 9 severely politically affected VDCs and 13 VDCs with populations of less than 4000, 60 were selected randomly for inclusion. After mapping, households were identified and data collected over two years. Each village development committee has an average population of around 8,000. In each, selected key informants provided information prospectively about every birth and death to village development committee interviewers. The interviewers verified each event and visited families at six weeks after delivery to administer a questionnaire. In the event of a stillbirth or neonatal death, they visited within three months to administer a verbal autopsy. The study was explained to participants and consent taken. We used a verbal autopsy tool which combined open-ended narrative with closed questions and was developed in light of other tools: the original WHO infant verbal autopsy[25], a tool updated in 2002 by the INDEPTH network, and a new tool in development (WHO/JHU/AKU/SNL 11/05/2003). Confidentiality was maintained by interviewing individuals or family groups separately and not discussing the matter openly.

Analytical methods

Questionnaires were entered in an electronic database in Microsoft Access (Microsoft Corporation). We based our classification of cause of death on the Neonatal and Intrauterine Death classification according to Etiology (NICE)[26], and the WHO Neonatal Child Health Epidemiology Reference Group (CHERG)[27]. Narratives and responses to closed questions were reviewed independently by two pediatricians (SRM and AO). Cause of death was classified according to the algorithm shown in Box 1. Cases in which the two paediatricians did not agree were discussed with a consultant neonatologist (DSM) and a final diagnosis was assigned by consensus. Further analysis was carried out in SPSS 11.5 (SPSS Inc., Illinois). The findings are presented as frequencies and proportions.

Ethical issues

Study approval was obtained from the Nepal Health Research Council (NHRC), the ethical committee of Great Ormond Street Hospital and the Institute of Child Health and the Social Welfare Council of Nepal. Informed consent in local or Nepali languages was obtained from respondents prior to interview. No data used in the analysis contained the names of participants.

Results

Data were collected over two years from 1st September 2006 to 31st August 2008. There were 25 982 deliveries in this period, with 813 stillbirths and 954 neonatal deaths. Verbal autopsies were available for 601 stillbirths and 671 neonatal deaths (72% of all). Reasons for missing autopsies included political conflict and instability in the district, transportation problems and absence of male

head of household to give permission for interview. Information on stillbirths, early and late neonatal deaths is presented in Table 1. The study PMR was 60 per 1000 births and the NMR 38 per 1000 live births. Deaths were slightly more common in male infants (56%) and most of the infants were born at term (76%).

The classification of cause of death is presented in Table 2. Of 601 stillbirths, 504 (84%) were fresh and 97 (16%) macerated. Obstetric complications were the leading cause (67%), followed by prematurity (10%). 10% of perinatal deaths were unclassifiable on the basis of the questionnaire. Among neonatal deaths, 529 (79%) were early and 142 (21%) late. The three leading causes of neonatal deaths were birth asphyxia (37%), severe infection (30%) and prematurity or low birth weight (15%).

Table 3 summarises characteristics of delivery. Most of the infants (65%) were delivered at home. Many deliveries were conducted by relatives (28%), and only 26% were assisted by doctors. 20% were conducted by village practitioners who are untrained health workers. It is interesting to note that 50% of women received an injection (presumably of an oxytocic drug, Oxytocin) during home delivery to augment labour. Among neonatal deaths, 886 (74%) infants were reported by their mothers as being of normal size. In 53% of births, the umbilical cord was cut with unsterilised instruments, and dung or ash was applied to the cut end of the cord in 20% of cases. Nearly a third of infants were not fed anything within half an hour of birth and 23% were given goat's milk as the first feed.

Table 4 examines the circumstances of presumptive birth asphyxia and resuscitation. Among neonatal deaths, 41% of infants did not cry immediately after birth and some attempt at resuscitation was made in 90% of cases. Half of the infants with presumptive birth asphyxia did not cry at all. The commonest resuscitative measure was mouth-to-mouth respiration (49%). In terms of treatment in general – not only for birth asphyxia - 365 (56%) of 646 infants who died in the neonatal period did not receive any form of treatment. The main reasons given for this were poverty, unavailability of a male family member who could take a decision in time, and an assumption that infants would not survive. Of the 44% of infants who did receive treatment, 244 (88%) were seen by allopathic health care providers: 106 (38%) at hospitals, 63 (23%) at other institutions such as nursing homes and clinics, and 75 (27%) at home. 35 (12%) received treatment from providers such as traditional healers (*jhankri*) and herbalists.

Table 5 compares some of the characteristics of infants who died with those of infants who survived. Out of 25,169 surviving infants, information was available on 17,377 (69%). Migration of mothers to neighbouring districts, transportation problems and political conflicts were the main reasons for missing data. 1% of infants were preterm in the surviving group, compared to 24% in the group who survived. Village practitioners delivered 6% of infants in the group who survived, and 19% of those who died. Description of symptoms of birth asphyxia was commoner in the group who died (41%) than in the surviving group (14%).

Table 1: Births, stillbirths and neonatal deaths in 60 village development committees of Dhanusha district, 2006-2008

Category	**Frequency**
Births	25 982
Stillbirths	813
Live births	25 169
Neonatal deaths	954
Early neonatal deaths	760
Late neonatal deaths	194
Perinatal deaths (stillbirths and early neonatal deaths)	1 573
Stillbirths classified on the basis of verbal autopsy	601
Neonatal deaths classified on the basis of verbal autopsy	671
Indicator	**Rate**
Stillbirth Rate per 1000 births	31
Neonatal Mortality Rate per 1000 live births	38
Early Neonatal Mortality Rate per 1000 live births	30
Late Neonatal Mortality Rate per 1000 live births	8
Perinatal Mortality Rate per 1000 births	60

Table 2: Causes of stillbirth and neonatal death in 60 village development committees of Dhanusha district, 2006-2008

Stillbirth	**Frequency**	**(%)**
Obstetric complications	403	(67)
Prematurity	63	(10)
Maternal specific conditions	41	(7)
Congenital malformations	16	(3)
Multiple pregnancy	10	(2)
Others	9	(1)
Unclassifiable	59	(10)
Total	***601***	***(100)***
Neonatal death		
Birth asphyxia	250	(37)
Severe infection	205	(30)
Prematurity or low birth weight	101	(15)
Hypothermia	45	(7)
Congenital malformations	6	(1)
Others	33	(5)
Unclassifiable	31	(5)
Total	***671***	***100***

Table 3: Characteristics of delivery for 1272 stillbirths and neonatal deaths in 60 village development committees of Dhanusha district, 2006-2008

Place of delivery	**Frequency**	**(%)**
Home	826	(65)
Hospital	254	(20)
Other health institution (primary health centre, private clinic)	145	(12)
On the way to hospital	30	(2)
Other	17	(1)
Total	**1272**	**(100)**
Delivery conducted by		
Relative	360	(28)
Doctor	341	(27)
Village practitioner[1]	241	(19)
Health worker[2]	161	(13)
Volunteer[3]	105	(8)
Other (friend, neighbor)	14	(1)
Alone	50	(4)
Total	**1272**	**(100)**
History of Injection given to mother		
Yes	628	(50)
No	640	(50)
Total	**1268**	**(100)**
Umbilical cord cutting instrument		
Unboiled instrument	345	(53)
Boiled blade	118	(18)

Table 3 cont...

Table 3 cont...

Other	10	(1)
Unable to recall	180	(28)
Total	**653**	**(100)**
Umbilical stump application		
Nothing applied	240	(37)
Others (dung or ash)	134	(21)
Oil	28	(4)
Antiseptic (Dettol)	23	(3)
Unable to recall	228	(35)
Total	**653**	**(100)**
Infant's first feed		
No prelacteal feeds	203	(30)
Goat's milk	155	(23)
Prelacteal (Honey, sugar, clarified butter)	112	(17)
Mother's breast milk	80	(12)
Other mother's breast milk	72	(11)
Cow or buffalo milk	9	(1)
Infant formula	3	(<1)
Unable to recall	37	(6)
Total	**671**	**(100)**

[1] Untrained health worker who conducts delivery in the community

[2] Health assistant, staff nurse, auxiliary health worker, community medical assistant, auxiliary nurse midwife, maternal and child health worker

[3] FCHV: Female community health volunteer; TBA: Trained birth attendant

Table 4: Asphyxial conditions and resuscitation at delivery, for 671 neonatal deaths in 60 village development committees of Dhanusha district, 2006-2008

	Frequency	**(%)**
Infant cried immediately after birth		
Yes	395	(59)
No	276	(41)
Total	**671**	**(100)**
Time until infant cried, if not immediately		
Within 5 min	22	(8)
5 – 30 min	67	(25)
> 30 min	44	(17)
Never cried	132	(50)
Total	**265**	**(100)**
Resuscitation measures		
Mouth-to-mouth respiration	111	(45)
Tactile stimulation	77	(31)
Mouth to tube-and-mask ventilation	47	(19)
Bag-and-mask ventilation	13	(5)
Total	**248**	**(100)**

Table 5: Treatment modalities for 646 neonatal deaths in 60 village development committees of Dhanusha district, 2006 – 2008

	Frequency	(%)
Treatment received		
Yes	281	(44)
No	365	(56)
Total	**646**	**(100)**
Treatment given at:		
Hospital	106	(38)
Other health institute (private clinic, nursing home)	63	(23)
Home	75	(27)
Traditional healers (jhankri, herbalists)	35	(12)
Total	**279**	**(100)**

Table 6: Comparison of characteristics of 17 377 infants who survived and 1272 infants who were stillborn or died in the neonatal period, in 60 village development committees of Dhanusha district, 2006-2008

		Infants who survived 28 days n=17 377		Stillbirths and perinatal deaths n=1272	
		Frequency	**(%)**	**Frequency**	**(%)**
Infant sex	Male	9147	(53)	713	(56)
	Female	8230	(47)	559	(44)
	Total	**17377**	**(100)**	**1272**	**(100)**
Maturity	Term	17110	(99)	970	(76)
	Preterm	181	(1)	302	(24)
	Total	**17291**	**(100)**	**1272**	**(100)**
Place of delivery	Home	14100	(82)	826	(65)
	Hospital	2324	(14)	254	(20)
	Other health Institution	602	(4)	145	(12)
	On the way to hospital	107	(<1)	30	(2)
	Other (including vehicle delivery)	101	(<1)	17	(1)
	Total	**17234**	**(100)**	**1272**	**(100)**
Birth attendant	Relative	5607	(34)	360	(28)
	Doctor	1623	(10)	341	(27)
	Village practitioner	978	(6)	241	(19)
	Health worker	2104	(13)	161	(13)
	Volunteer	5159	(31)	105	(8)
	No attendant	500	(3)	50	(4)
	Others (friends, neighbors)	460	(3)	14	(1)
	Total	**16431**	**(100)**	**1272**	**(100)**
Umbilical cord cutting implement	Unboiled instrument	10614	(66)	345	(53)
	Boiled blade	4687	(29)	118	(18)
	Other	54	(<1)	10	(1)

Table 6 cont...

Table 6 cont...

	Not recalled	660	(4)	180	(28)
	Total	**16015**	**(100)**	**653**	**(100)**
Infant cried immediately	Yes	9968	(86)	395	(59)
	No	1627	(14)	276	(41)
	Total	**11595**	**(100)**	**671**	**(100)**
Umbilical cord application	Applied nothing	5508	(35)	240	(37
	Oil	1986	(13)	28	(4)
	Antiseptic (Dettol)	1435	(9)	23	(3)
	Other (dung, ash)	5637	(36)	134	(21)
	Not recalled	1163	(7)	228	(35)
	Total	**15729**	**(100)**	**653**	**(100)**
First feed	No prelacteal	0	(0)	203	(30)
	Goat's milk	5255	(31)	155	(23)
	Mother's breast milk	4175	(24)	80	(12)
	Other mother's breast milk	4123	(24)	72	(11)
	Prelacteal (Honey, sugar, clarified butter)	3042	(18)	112	(17)
	Cow, buffalo milk	282	(2)	9	(1)
	Infant formula	181	(1)	3	(<1)
	Not recalled	60	(<1)	37	(6)
	Total	**17118**	**(100)**	**671**	**(100)**
Treatment given	Yes	8869	(54)	365	(56)
	No	7568	(46)	281	(44)
	Total	**16437**	**(100)**	**646**	**(100)**

Box 1: Classification of stillbirth and neonatal death

Criteria	*Classification*
Infant did not breathe, cry or move at birth, weighing >1000 g or >28 weeks	**Stillbirth**
Baby looked swollen, puffy face with skin peeling	**Macerated stillbirth**
Normal looking baby with skin intact, implying death <12 hours before delivery, weighing >1000 g	**Fresh stillbirth**
Gross visible malformation, such as meningomyelocele, anencephaly, gastrochisis	**Lethal congenital malformation**
Prolonged labour >24 hrs, bleeding per vaginam, antepartum hemorrhage, postpartum hemorrhage, cord prolapse, cord around infant's neck, pregnancy induced hypertension, eclampsia, ruptured uterus, emergency caesarean section, malpresentation	**Obstetric complications**
Birth weight <2500 g and age <36 weeks, or pregnancy ended early and infant was smaller than usual at birth	**Prematurity**
History of chronic illness like Diabetes, Tuberculosis, Rheumatic Heart Disease, HIV, Epilepsy to mother	**Maternal disease**
Twin or triplet	**Multiple pregnancy**
External trauma to mother during pregnancy	**Accident or external condition**
Above conditions not fulfilled and other cause discernible from history	**Other**
Cause could not be ascertained due to lack of information	**Unclassifiable**
Infant breathed, cried or moved at birth, but died before 28 complete days	**Neonatal death**
Death within 4 hours of birth or gestational age > 36 weeks and not able to breathe normally at birth, or not able to suckle normally at birth, convulsions or spasms, but not tetanus or fever. *Supportive criteria: history of prolonged labour, malpresentation, twin, very large baby	**Birth asphyxia**
Fever or cold and limp or lethargic or convulsions or bulging fontanel and refusing to feed and no localizing signs Duration >1 day and chest indrawing or difficulty breathing Umbilical area red or discharging pus or skin red, inflamed or hot or skin rash with pustules or pus and fever >1 day Age 3-27 days and convulsions or spasms and able to suckle and cry normally after birth and stopped suckling or crying **Supportive criteria: use of dirty instruments to cut the cord, red and discharging umbilicus, not completed tetanus toxoid immunization course	**Severe infection**
Birth weight <2500 g and age <36 weeks, or pregnancy ended early and infant was smaller than usual at birth	**Prematurity or low birth weight**
Especially in winter months and history of having been bathed immediately after birth	**Hypothermia**
Gross visible malformation, such as meningomyelocele, anencephaly, gastrochisis	**Congenital malformation**
Bruises or marks of injury on body or head at birth	**Accident or external condition**
Above conditions not fulfilled and due to other reasons	**Others**
Cause could not be ascertained due to lack of information	**Unclassifiable**

Discussion

The commonest cause ascribed to stillbirths was obstetric complications. This may reflect either delay in receiving appropriate obstetric care due to geographical difficulty or poor antepartum and intrapartum obstetric care. The fact that 504 stillbirths (84%) were fresh suggests that infants might have been viable during labour. Better intrapartum foetal monitoring with timely intervention might reduce the fresh stillbirth rate. Lack of skilled providers in the community could be one reason for the high fresh stillbirth rate. Birth asphyxia was found to be the commonest cause of neonatal death. This also indicates a lack of proper intrapartum monitoring, timely and appropriate intervention and neonatal resuscitation in the community. Indeed, the combination of fresh stillbirths and early neonatal deaths from asphyxia probably reflects the same process[28]. In this study population, 65% of deliveries were at home and most (59%) were assisted by untrained persons. This reflects the national scenario in which 80% of deliveries are conducted by relatives at home[29].

A verbal autopsy analysis from Egypt found prematurity (39%), asphyxia (18%) and infections (7%) to be the commonest causes of neonatal deaths[30]. Among perinatal deaths, birth asphyxia was the commonest cause (44%). In a study in rural Pakistan, the main causes of neonatal death were asphyxial conditions, neonatal sepsis and conditions associated with prematurity[31]. 65% of neonatal deaths occurred at home and most of the deliveries were conducted by *dais* (untrained birth attendants). In a study from rural Maharashtra (India), Kulkarni et al found that low birth weight (36%) was the main cause of early neonatal deaths, followed by prematurity (26%)[32]. Prematurity was the commonest cause of stillbirth, and women under 21 years old were reported as having higher rates of premature delivery.

Few community verbal autopsy studies have been done in Nepal. In Morang district, Khanal et al found that infection (41%), birth asphyxia (37%) and prematurity or low birth weight (18.4%) were common causes of neonatal death[33]. They also found that infection was seen mostly after home deliveries. Wrapping of infants with unclean cloth, cutting the umbilical cord with unsterilised instruments, and birth attendance conducted by relatives, were possible reasons for this. Our study also showed that severe infection was the second most common cause of neonatal death. In as many as 20% of cases, dung or ash was applied to the umbilical stump. A similar study from Sarlahi district found that birth asphyxia (33%), serious infection (30%) and prematurity (29%) were the commonest causes of neonatal death[34]. This again suggests sub-optimal intrapartum and postnatal care in the community. The study also identified 30 cases of neonatal tetanus, which may have been due to inadequate coverage of tetanus toxoid immunisation and traditional cord care practices.

Our study highlights another important issue. Neonatal deaths caused by infection tend to occur later, while early deaths are more often associated with birth asphyxia[35]. In previous studies, and in global estimates, deaths from infection, preterm and asphyxia have tended to occur at similar rates[27,36,37]. The proportion of neonatal deaths in the first week has tended to be 60-70%. In our study, early neonatal deaths accounted for almost 80% of neonatal deaths, and asphyxia 41%. This means that asphyxial deaths are becoming the dominant problem, an interpretation that is intuitive in the sense that the numbers of late neonatal deaths are falling. An emphasis on intrapartum care is required, and this fits well with the safer motherhood agenda and recommendations. One worrying issue is the high incidence of oxytocic injection, often delivered in uncontrolled environments. This potentially harmful practice has become common and our finding of a level of 50% is a cause for concern that supports both anecdotal information about practices in the district and previous research[38].

Conclusion

The current high rates of stillbirth and neonatal death in Dhanusha suggest that the quality of care provided during pregnancy and delivery remains sub-optimal. The high rates of stillbirth and asphyxial mortality imply that, while efforts to improve hygiene need to continue, intrapartum care is a priority. A second area for consideration is the need to reduce the uncontrolled use of oxytocics for augmentation of labour.

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