

Intrapartum and Neonatal Mortality in a Traditional Indigenous Community in Rural Guatemala

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We identified high rates of intrapartum and neonatal mortality among children born in a traditional indigenous community in rural Guatemala. To examine the potential association of maternal characteristics and obstetric and newborn care practices with this mortality, we conducted a retrospective case-control study. Cases were infants born in 1986 and 1987 who died during birth or in the first month of life, as identified by civil records; for each case, the next child born who survived the first month of life was selected as control. In interviews with mothers of cases and controls standardized data were collected on demographic and socioeconomic characteristics of the mother, her general obstetric history, history of the pregnancy, labor, and delivery, condition and care of the infant at birth, and morbidity and treatments of the infant after birth. Sixty-one cases and their controls were included in the study. Based on clinical condition at birth, we subcategorized cases into infants stillborn or dying in the first 24 hours of life (intrapartum cases) and those dying in the first month after day 1 (neonatal cases). Factors significantly associated with both subcategories of cases were maternal illiteracy, primagravity, failure to use "modern" prenatal care, and inter-birth interval < 14 months. Intramuscular injection of oxytocin by the midwife during labor, and performance of ≥ 3 vaginal examinations by the midwife were each significantly associated only with the intrapartum subcategory of cases. Mother's estimate of infant size as "smaller than normal" was associated with neonatal, but not with intrapartum, cases. Reported clinical features of cases suggested birth asphyxia and/or trauma to be predominant among intrapartum cases, and sepsis to be the most common cause of neonatal mortality after day 1. *Key words:* neonatal mortality, perinatal mortality, traditional birth attendants, Guatemala.

Perinatal and neonatal mortality have received less attention than diarrhea, vaccine-preventable diseases, and respiratory infection in programs aimed at improving child health in the developing world. In October 1986, we conducted a census combined with a maternal fertility/child mortality survey in a traditional indigenous community in the Guatemalan highlands. This survey indicated that half of the deaths reported in children under the age of three years were intrapartum (IP) and neonatal (NN) infant deaths. Civil records in this community for the years 1981–1985 revealed that of 2 186 births, 88 (4.0%) reportedly had resulted in IP death and 50 infants (2.3%) reportedly had died in the first month of life. Review of INCAP data collected two decades earlier in the nearby indigenous highland community of Santa Maria Cauqué revealed that 4.0% of 2 358 pregnancies ended in stillbirth, and that 3.7% of liveborn infants died in the first month of life (1).

The magnitude of these IP and NN mortality rates, and similarity despite two intervening decades, prompted us to conduct this case-control study to examine the

association between specific characteristics and conditions of mothers, pregnancies and deliveries, the condition and care of the newborns, with the risk of IP/NN mortality, and to gain insight into the medical events associated with this mortality.

MATERIALS

Population. The study was carried out during November 1987–April 1988 in Santa Maria de Jesús, Sacatepequez, Guatemala. This is a rural municipality of just over 10 000 inhabitants, almost all of whom are Cakchikel Maya indians. The 1986 INCAP surveys found 82 % of male heads of household to be subsistence farmers, the mean family size to be five persons, the female literacy rate to be 39 %, and 79 % of families to live in houses with earthen floors.

Cases and controls. Cases were children born in 1986 and 1987 who died during birth or in the first month of life, as identified from civil records. For each case one control was selected, defined as the next child born after that case, identified from the same civil records. Birth registration is required to receive the government identification documents required of all Guatemalans, and death registration is required for burial in the community's cemetery. For this study we did not seek birth or death information from other sources.

Collection of data. Data on each case and control were collected using a standardized instrument. All interviews were with the mother of the case or control child with the exception of one case whose mother had died from post-partum hemorrhage; the informant in that case was the mother-in-law, who had been present during labor and delivery.

The interview included verification of "case" and "control" status and of age at death of each case. The following data, applying at the time of birth, were then collected for each case and control:

General characteristics. Occupation of head of household, family size and age group composition; maternal age, literacy, civil status, occupation, and work outside the household.

General obstetric history of the mother. Total number of pregnancies; previous abortions, stillbirths, neonatal, infant and child deaths, caesarean sections; anti-tetanus vaccination.

Prenatal history of study child. Estimated duration of pregnancy (months), interval between previous birth and birth of study child, number of fetuses, weight gain (if known), specific illnesses and treatments (by trimester), source(s) of prenatal care (by trimester).

History of labor and delivery. Place of birth (home, midwife's home, clinic, hospital); duration of ruptured amniotic membranes, duration of labor (hours), birth attendant, vaginal or caesarean birth, fetal presentation, prolapse of cord, hemorrhage, fever, other complications, manipulation and treatments during labor, number and frequency of injections of oxytocin.

Condition and treatment of newborn. Birthweight (if known), estimated size ("normal", "small", "other"), activity at birth and shortly after birth (cry, movement, color, respirations), odor, bruises or other injuries; malformations; specific treatments and care.

Conditions and treatments in first month of life (birth survivors only). Bathing, cord care, feeding; symptoms and treatments for all illness episodes (including terminal episode in cases) by day or week of life; sources of care.

Analysis. Associations of individual variables with mortality were initially examined in univariate analysis using non-parametric statistical methods (χ^2 test, Fisher's exact test). Continuous variables were categorized based on existing literature or on detection of logical break-points in the data. Interactions between independent variables were examined in stratified univariate analyses. Finally, variables significantly associated with mortality were examined in a full logistic regression model, using the CATMOD procedure of SAS-PC version 6.03 (SAS Institute Inc, Cary, North Carolina, USA).

RESULTS

A total of 71 families with case infants were identified. Of these, three maintained their census registration in the study community but lived elsewhere, four refused to participate in the study, and three could not be located within the community. Thus, the data and analysis pertain to the 61 (86 %) cases interviewed and their respective controls. Table 1 shows general characteristics of study families and mothers.

Subcategorization of mortality. Symptoms of the six case infants born with signs of life but dying in the first twenty-four hours indicated these infants to have been born extremely depressed, suggesting their deaths to be related to IP events. Therefore, we defined IP mortality as including stillborns with movement *in utero* entering labor and infants dying in the first day of life; 29 (48 %) of the 61 cases were in this subcategory. Infants dying in the first month of life after the first day were subcategorized as NN cases. Because some factors associated with IP mortality might be distinct from those associated with NN mortality, these subcategories of cases were utilized in univariate analysis of risk factors, using χ^2 tests with two degrees of freedom.

Univariate analysis. The significant risk factors identified by this analysis are presented in Table 2. Five variables were significantly more common in both subcategories of cases than in controls. Illiteracy was reported in 77 % of mothers of cases, compared to 54 % of controls. Primagravida status was identified in 31 % of mothers of cases, compared to 10 % of controls. Modern health services—the government health post or church clinic in the community, the area hospital, or a private physician—were used for prenatal care by 21 % of case mothers, versus 44 % of control mothers. Antitetanus vaccination was also significantly less frequent in case than control mothers (8 % vs. 24 %, $p < 0.05$) and was identified only in mothers using modern health services. However, since none of the clinical patterns of neonatal death suggested tetanus as etiology, we interpreted tetanus vaccination to be a proxy for use of modern prenatal services. Of note was the fact that only half of all women receiving modern prenatal care had received vaccination against tetanus.

Of the five practicing midwives in the community, attendance of the birth by one ("midwife A") was significantly associated with risk of IP as well as NN mortality. This midwife was the oldest, least expensive, least trained, and attended the largest number of births.

Among multigravidas, inter-birth intervals <14 months were identified in 50 % of the 42 mothers of cases, versus 15 % of the 54 mothers of controls. Among all multiparous mothers (regardless of case/control status), inter-birth interval <14 months was strongly associated with death of the preceding child at less than one

Table 1. *Characteristics of study families and mothers*

| Characteristics | Cases (n=61) (%) | Controls (n=61) (%) |
|---|---------------------|------------------------|
| Indigenous Maya | 100 | 100 |
| Father present in household | 95 | 98 |
| Mother's principal occupation = domestic tasks/weaving | 88 | 84 |
| Mothers age | | |
| 15–19 years | 6 | 3 |
| 20–29 years | 59 | 56 |
| 30–39 years | 24 | 34 |
| > 40 years | 11 | 7 |
| Place of delivery | | |
| Home | 88 | 84 |
| Midwife's home | 2 | 3 |
| Hospital (elective) | 5 | 13 |
| Hospital (emergent) | 5 | 0 |

year of age ($\chi^2=11.082$, 1 d.f., $p<0.001$). However, the association of short inter-birth interval with case status was not explained by history of previous IP/NN mortality nor by death of the preceding child, neither of which were themselves significantly associated with IP/NN mortality in the study child. Moreover, in the 71 multiparous case or control mothers whose previous child had not died in infancy, short inter-birth interval itself was significantly associated with IP/NN mortality ($\chi^2=6.583$, 1 d.f., $p<0.02$).

Receipt of intramuscular injection of oxytocin during labor, and having ≥ 3 vaginal examinations performed by the midwife during labor, were significantly associated with the IP subcategory of cases. Intramuscular injection of oxytocin during labor was extremely common in the study population: 54% of mothers of controls and 50% of mothers of NN cases received one or more such injections. However, the proportion of mothers of IP cases who received oxytocin injections was significantly higher (83%, $p<0.01$). The association of oxytocin with IP cases was not confounded by prolonged labor, abnormal fetal presentation, or midwife attending the birth (Table 3). Primagravidas were somewhat more likely than multigravidas to receive oxytocin (72% versus 56%), and when injected with oxytocin their infants were more likely to experience IP mortality than infants of other primagravidas (44% versus 28%); however, neither of these differences was significant with the number of cases studied.

Vaginal examinations by the midwife were reported by 76% of the 108 mothers whose complete labor and delivery were attended by a midwife. However, the performance of ≥ 3 vaginal examinations was significantly associated with IP mortality, though not with later NN death. Performance of ≥ 3 vaginal examinations was significantly correlated with receipt of oxytocin injections, but like oxytocin this factor was not associated with a specific midwife nor with prolonged labor.

Only one factor—mother's estimation of infant size as "smaller than normal"—was significantly associated exclusively with the NN cases.

Table 2. *Univariate analysis of risk factors in subcategories of cases and in controls*

| Factor | IP cases: stillborn or death age < 1 day ($n=29$) (%) | NN cases: neonatal deaths after day 1 ($n=32$) (%) | Controls ($n=61$) (%) | P^a |
|---|--|---|-------------------------------|--------|
| | | | | |
| Mother illiterate | 72 | 81 | 54 | 0.025 |
| Primagravida | 31 | 31 | 10 | 0.015 |
| Use of "modern" prenatal care | 17 | 25 | 44 | 0.025 |
| Birth attended by "comadrona A" | 59 | 47 | 31 | <0.05 |
| Inter-birth interval < 14 months (multigravidas only) | 45 (20) | 59 (22) | 15 (54) | <0.001 |
| Received intramuscular oxytocin during labor | 83 | 50 | 54 | <0.01 |
| ≥ 3 vaginal examinations (complete labor in community) | 48 (29) | 12 (26) | 17 (53) | 0.001 |
| Mother's estimate of newborn size = "smaller than normal" | 34 | 69 | 39 | <0.01 |

^a χ^2 test, 2 degrees of freedom.

Several medical events appeared to be strongly associated with mortality, although their occurrence was too infrequent in this small study population to give sufficient power to statistical analysis. These events are presented in Table 4.

Multivariate analysis. The five factors associated with case versus control status were examined in a full logistic regression model. In this model, primagravida status had the strongest association with risk of mortality (χ^2 12.51, 1 d.f., $p=0.0004$). Inter-birth interval <14 months, maternal illiteracy, and non-use of modern prenatal care also maintained significant associations with mortality ($p=0.0025$, 0.0035, and 0.05, respectively). However, in this model attendance by "midwife A" was not significantly or substantially associated with mortality ($p=0.40$), suggesting that her association with mortality in univariate analysis resulted from the combined effects of other factors present in her clientele.

Evaluation of clinical information. Based on the mother's descriptions of condition and symptoms of the infant at birth and during the terminal illness, we attempted to classify probable causes of mortality in study infants. All IP cases were reportedly born without signs of life or extremely depressed, suggesting for the majority IP asphyxia or trauma as cause of death. Five IP cases were described as bruised or suffering an apparently traumatic delivery. In one IP case, maternal fever and foul-smelling amniotic fluid were reported at birth after over 24 hours of ruptured membranes. Delivery of two IP cases was accompanied by substantial hemorrhage; the mother of one of these died as a result of this hemorrhage.

Table 3. Examination of variables potentially confounding association of oxytocin use during labor with intrapartum mortality

| Factor | Percent receiving oxytocin (%) |
|----------------------------|--------------------------------|
| Duration of labor | |
| < 12 hours ($n=95$) | 60 |
| \geq 12 hours ($n=25$) | 60 |
| Fetal presentation | |
| Normal ($n=113$) | 60 |
| Abnormal ($n=9$) | 56 |
| Midwife | |
| "A" | 58 |
| Other | 62 |

Table 4. Infrequent medical events with high risk of intrapartum or neonatal mortality

| Event | Number | IP deaths | NN deaths |
|--|----------------------------|-----------|-----------|
| Prematurity | 6 | 2 (33 %) | 4 (67 %) |
| Rupture of amniotic membranes > 24 hours | 3 | 3 (100 %) | — |
| Abnormal fetal presentation | 9 (8 breech, 1 transverse) | 4 (44 %) | 3 (33 %) |
| Twins | 2 | 1 (50 %) | — |

Of the 32 NN cases, four were premature; of these, at least one had apparent severe respiratory difficulties and died early and another had abdominal distension followed by rapidly progressive decline in activity and sucking. The most common clinical picture, present in two-thirds of NN cases, was decreased activity and sucking, followed shortly thereafter by death; in some cases the infant was described as "cold" before death occurred. In no case were trismus, convulsions or rigidity reported upon specific questioning; we therefore interpret these findings probably to represent neonatal sepsis rather than neonatal tetanus, since one or more of these symptoms is almost always identified in neonatal tetanus in the developing world (2, 3). In four additional NN cases, respiratory difficulties accompanied these general symptoms. One NN case died with severe congenital malformations (apparently myelomeningocele), one died with umbilical and other hemorrhage, and one died in bed with its parents without antecedent symptoms. In one case the mother could not describe the terminal illness.

DISCUSSION

In the developing countries of Middle America as in other regions, perinatal and neonatal mortality are important components of infant and child mortality. At the beginning of the 1980s, 28% of all reported deaths in Middle America occurred in the first year of life (4). Of known causes of this infant mortality, "perinatal conditions" were the first or second most common in all countries except Nicaragua (4). Most studies of neonatal and perinatal mortality in developing countries have been hospital-based, and may not represent the majority of the population at risk in these countries nor indicate the predominant causes of such mortality (5). Thus, the real importance and etiologies of neonatal and perinatal mortality in developing countries remain undefined.

Based on civil records in our study community during the two-year period of this study, NN deaths represented 46% of all deaths of liveborn children under five years of age. With the additional deaths of children reportedly alive at the onset of labor but dying during birth, IP plus NN death accounted for 60% of all child deaths under age five years in the community. These data are consistent with our earlier findings in this community, and with INCAP data from a rural indigenous Guatemalan community two decades ago (1).

We employed retrospective case-control methodology for this initial investigation of IP/NN mortality. Although restricted to data derived from the memory of the mothers interviewed, this methodology has recently been recommended by international health agencies to identify rapidly and inexpensively factors associated with common public health problems in the developing world (6, 7). To minimize the problems associated with this methodology, we employed standardized data collection by a single interviewer (M.E.P. de B). Being a female and a Guatemalan physician already known in the community, this interviewer had little difficulty obtaining interviews with the female informants, while having the medical expertise required to obtain meaningful obstetric and pediatric information. The clinical data collection combined elements of medical history-taking with the "verbal autopsy" technique (8).

This methodology may in part be validated by the fact that our findings regarding risk factors for IP/NN mortality are consistent with those of other studies: maternal illiteracy, first pregnancy, short inter-birth interval, and lack of modern prenatal care have all been demonstrated by studies in the developed and developing world

to be associated with high risk of perinatal and neonatal mortality (9–14). Risk at the extremes of reproductive age was not adequately tested in our study population. Death of a previous newborn, found in some studies to be associated with NN mortality, was not a significant risk factor in our population. However, in our population inter-birth interval < 14 months was strongly associated with death of the preceding child during infancy, consistent with the suggestion that short inter-birth interval may be a link between death of a preceding child and risk to the next (15).

One important element which our present study is unable to address is the relation of low birthweight (LBW) to mortality and to the risk factors we identified. Several of the risk factors for IP/NN mortality identified by this and other studies are also associated with LBW (5, 16–17). In both the developed and the developing world, LBW is a major determinant of infant mortality (16–18). Although reliable birthweights are not available for the children in our retrospective study, NN case infants were more likely to be estimated by their mothers to be “smaller than normal”. This estimate is fraught with potential biases: prospective validation is being conducted in the study community.

Whether or not NN mortality occurs principally in LBW infants, reducing such mortality will probably require knowing the principal clinical entities involved. In Santa Maria Cauquè, where 74% of neonatal deaths occurred in LBW infants (1). Urrutia et al. found all of the causes of neonatal death to be either pneumonias or septicemic infections, potentially treatable conditions even in high-risk newborns (19). These diagnoses are consistent with our findings in respect to NN mortality. The absence of neonatal tetanus was specifically noted by physicians in Santa Maria Cauquè and is suggested in our population by our findings and subsequent interviews with midwives and health workers. However, past INCAP studies in lowland populations of Guatemala did find tetanus to be a component of NN mortality there (11).

In regard to IP mortality, our data identify two factors not previously described which were strongly associated with risk. Both of these factors are specific obstetric practices employed by the midwife, apparently adopted inappropriately from modern medical practice. The use of intramuscular oxytocin injection is of particular concern, since it is biologically plausible that its association with IP mortality is a direct causal relationship. Our analysis suggests that the use of oxytocin was not elicited by other obstetric factors such as prolonged or obstructed labor which were responsible for the IP death. Interviews with mothers and midwives indicate that injections are given, and requested by mothers, to “give more force” to the mother’s contractions. Some families purchase ampules of oxytocin in anticipation of labor, or pay an injectionist to administer oxytocin during labor. Although supposedly controlled, oxytocin is available over-the-counter in pharmacies in the study community and throughout Guatemala and is found in the homes of midwives in the study community (A.B., personal observations). Re-education of midwives and control of this practice need to be priority issues in areas where the practice is prevalent.

The other “modern” practice commonly employed by midwives and associated with IP mortality was vaginal examination; 76% of all study mothers had at least one such examination. The association of vaginal examinations with IP death (as opposed to neonatal infection) is not likely to be causal, but rather to reflect the midwife’s perception that the labor is not progressing as it should. If this is true, these perceptions might be adapted as cues for patient referral. Midwives’ detection

and referral of other complicated pregnancies and deliveries which resulted in substantial risk of IP and NN mortality—malpresentations, premature labor, prolonged rupture of amniotic membranes, multiple fetuses—might result in additional reductions in mortality.

In Guatemala and other Central American countries, community midwives attend the majority of rural births. This fact indicates the potential importance of interventions which incorporate these midwives, including identification and modification of high risk practices, improved identification and referral of high risk pregnancies and births, and prevention and early detection of neonatal illnesses. Rational design of such interventions must be based on knowing the risk factors and specific causes of IP/NN morbidity and mortality. Our study suggests that the case-control method may be a useful tool for collecting such information. Validation is presently being carried out in the study community.

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