Levels and risk factors for perinatal mortality in Ahmedabad, India

D.V. Mavalankar,[1] C.R. Trivedi,[2] & R.H. Gray[3]

To estimate levels and determinants of perinatal mortality, we conducted a hospital-based surveillance and case–control study, linked with a population survey, in Ahmedabad, India. The perinatal mortality rate was 79.0 per 1000, and was highest for preterm low-birth-weight babies. The case–control study of 451 stillbirths, 160 early neonatal deaths and 1465 controls showed that poor maternal nutritional status, absence of antenatal care, and complications during labour were independently associated with substantially increased risks of perinatal death. Multivariate analyses indicate that socioeconomic factors largely operate through these proximate factors and do not have an independent effect. Estimates of attributable risk derived from the prevalence of exposures in the population survey suggest that improvements in maternal nutrition and antenatal and intrapartum care could result in marked reductions of perinatal mortality.

Introduction

Perinatal mortality is high in developing countries and as infant mortality has declined, deaths during the perinatal period have become a more important public health problem (*1*). The level of perinatal mortality is associated with socioeconomic development and availability of health care in the community (*2, 3*). Although in developed countries numerous risk factors for perinatal death have been identified (*4*), in developing countries only limited epidemiological information is available (*5–8*).

Perinatal mortality is particularly high in India, hospital-based estimates varying between 57 and 106 per 1000 births (*9*). For 1984, the national population-based estimate of perinatal mortality was 53.8 per 1000 births, of which the stillbirth rate was only 10.4 per 1000 (*10*). However, these figures are probably underestimates because of underreporting of stillbirths. In southern India a population surveillance study has reported perinatal mortality rates of 68.8 per 1000 in rural and 62.8 in urban areas (*11*). Research on risk factors for perinatal mortality in India has been limited, and has not taken into account the multiple causes (*12, 13*). The aim of the present study was to estimate the level of perinatal mortality, identify and quantify the risk factors, and assess the population-attributable risk for the most important of these factors in order to direct preventive interventions in the community.

Methods

In view of the difficulties in carrying out prospective studies in developing countries, where antenatal care is often inadequate and starts late in pregnancy, we used a combined approach that involved institutional surveillance and a case–control study linked to a population-based survey. The surveillance and case–control studies of levels and determinants of perinatal deaths and low birth weight were carried out in three government teaching hospitals in Ahmedabad (population, 2.5 million), a city in western India. The population-based survey was used to estimate the prevalence of risk factors in the community and to assess potential selection bias among mothers who gave birth in government hospitals.

Between July 1987 and June 1988 in the three participating hospitals there were 15 893 births, of which 739 were stillbirths and 517, early neonatal deaths—defined as occurring in hospital within the first week of life, since follow-up after discharge was not feasible. Of these perinatal deaths, detailed data for the case–control study were collected on 563 stillbirths (76.2%) and 222 early neonatal deaths (42.9%). Stillbirths were identified in the delivery room and the mothers were interviewed after birth. Early neonatal deaths were much harder to locate because they frequently occurred in paediatric or neonatal wards. The mothers were likely to be discharged soon after the death of their child and hence were more often missed by interviewers. The

[1] Visiting Fellow, National Institute of Child Health and Human Development, National Institutes of Health, Building EPN, Room 640, Bethesda, MD 20892, USA. Requests for reprints should be sent to this address.

[2] Associate Professor, NHL Municipal Medical College, Ahmedabad, India.

[3] Professor, Johns Hopkins University, School of Hygiene and Public Health, Baltimore, MD, USA.

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samples of stillbirths and early neonatal deaths whose mothers were interviewed for the case–control study were representative in terms of the distributions of their birth weight and of maternal parity. However, the early neonatal deaths that were missed tended to occur during the later part of the first week of life; hence our results for early neonatal mortality mainly represent deaths that occurred during the first few days of life.

Emergency referrals and twin births (112 stillbirths and 62 early neonatal deaths) were excluded from the case–control analysis and the final samples for the case–control study consisted of 451 stillbirths and 160 early neonatal deaths. Controls were selected from babies who weighed more than 2.5 kg and had survived the first 7 days of life or until discharge from the hospital, whichever was earlier. The controls were identified from births immediately following a perinatal death or delivery of a low-birth-weight infant. A total of 1517 mothers of control infants were interviewed, of whom 1465 were included in the study, after excluding emergency referrals and twin births.

Data on cases and controls were collected by interviewing the mothers, examining hospital records, and by carrying out anthropometric measurements of neonates on the second or third day after delivery. At the interview, information was obtained on maternal sociodemographic characteristics, past reproductive history, and behaviours, and use of health care services during the index pregnancy. Hospital records were abstracted for information on any medical conditions the mothers exhibited at the time of admission, mode of delivery, and interpartum complications, as well as the condition of the baby. Birth weight was measured to the nearest 50 g using pan-type spring scales. Gestational age was estimated from the date of the last menstrual period and by Cappuro's method, a modification of the Dubowitz scoring system, which uses only five somatic and two neurological parameters (*14*). All data were collected by physicians who were specially trained for the study.

The population-based survey covered 1102 women who had delivered in the previous year. A total of 71 of 4000 urban blocks covering Ahmedabad city were randomly selected from a sampling frame provided by the National Sample Survey Organization, and all eligible mothers in the selected blocks were included. A total of 92.3% of the women sampled were interviewed in their homes by trained physicians using a questionnaire similar to that administered to the case–control study mothers.

From the case–control study data, we estimated crude odds ratios and 95% confidence intervals (CI) for stillbirths and early neonatal deaths (*15*), and, for selected variables, χ^2 tests for trend (*16*). Adjusted odds ratios were estimated by logistic regression analysis, using the Statistical Analysis System (SAS) software package (*17*). A series of separate regression models were developed for socioeconomic, maternal biological, antenatal, and intrapartum factors. Each independent variable was categorized and represented by a set of binary (dummy) variables. Hierarchical combined models were created after excluding nonsignificant variables. Only final models are presented here. The 95% CIs were calculated for adjusted odds ratios (*15*), and separate models were used to assess the effect of past obstetric history among parous women.

The survey data were used to estimate the prevalence of risk factors in the community. Of the 1102 women surveyed, 562 (51%) had delivered in governmental institutions, 344 (31%) in private institutions, and 196 (18%) at home. The distribution of risk factors differed according to the place of delivery, but the prevalences of risk factors among the 562 mothers who delivered in government institutions were similar to those among the controls in the case–control study. The population-attributable risk percent (*18*) was calculated for the most important factors, based on the adjusted odds ratios determined in the case–control study and the prevalence of risk factors among survey mothers who had delivered in government institutions. For factors that could not be recorded in the population survey, e.g., blood pressure upon admission to hospital, data for the hospital controls were used to estimate attributable risk.

Results

The perinatal mortality rate in the study hospitals was 79.0 per 1000 births, the contribution to this from stillbirths being 46.4 per 1000 and from early neonatal deaths, 34.1 per 1000. The perinatal mortality, by birth weight and length of gestation, is shown in Fig. 1. As expected, perinatal mortality was very high among low-birth-weight preterm infants, and decreased exponentially with increasing birth weight and gestational period. Compared with full-term, normal-birth-weight infants, the relative risk (RR) of perinatal mortality was very high for preterm low-birth-weight babies (RR = 21.2, 95% CI = 17.8–25.2), but only moderately increased for full-term low-birth-weight babies (RR = 2.6, 95% CI = 2.1–3.2). Among stillbirths, 29% exhibited fetal heart sounds at the time their mothers were admitted for delivery, which suggests that these fetuses died during labour.

Fig. 1. **Distribution of perinatal mortality, by birth weight and length of gestational period.**

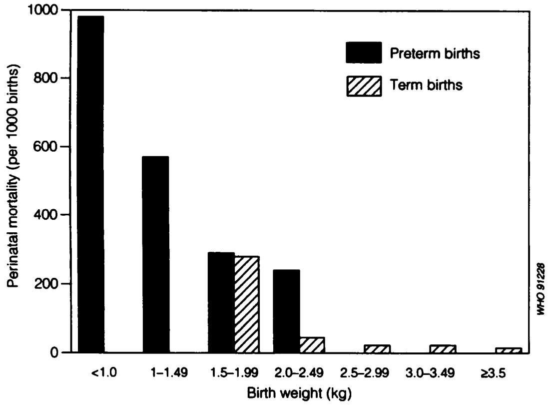

Table 1 shows the distribution of selected risk factors among stillbirths, early neonatal deaths and controls, as well as the crude odds ratios for each outcome. Characteristics of low socioeconomic status, such as lack of education, agricultural occupation, migrant status and lack of a toilet in the house, were associated with an increased risk for stillbirth and early neonatal death; low caste status and lack of a water tap in the house were associated with an increased risk of stillbirth. Among the maternal biological factors, age over 30 years and parity greater than three were significantly associated with an increased risk of stillbirth, but not of early neonatal death. However, a history of prior stillbirth or premature birth, interpregnancy interval $\leq$ 6 months, maternal weight $\leq$ 45 kg, and moderate or severe clinical anaemia were significantly associated with both adverse outcomes. Mothers with a history of more than one child death had a significantly greater risk of stillbirth. Antenatal factors, including inadequate antenatal care ($<$ 2 antenatal visits), insufficient use of iron and vitamin supplements ($<$ 5 weeks), decrease in dietary intake during the last trimester, and vaginal bleeding during pregnancy were also associated with significantly increased risks of stillbirth and early neonatal death. Oedema during pregnancy was significantly associated with stillbirth. Elevated diastolic blood pressure ($\geq$ 120 mmHg), convulsions, antepartum haemorrhage, breech delivery, Caesarean section, prolonged labour, and congenital malformations increased the risk of both stillbirth and early neonatal death. Birth asphyxia was also strongly associated with early neonatal death. Several factors showed significant χ^2 tests for trend, particularly a prior history of child deaths, maternal body weight, severity of anaemia, number of antenatal visits, and diastolic hypertension (Table 1).

Table 2 shows the estimates of the final logistic regression models for the risks of stillbirth and early neonatal death. Given are the adjusted odd ratios with 95% CI, the prevalence of risk factors among government hospital deliveries in the population survey, and the attributable risk percent for selected factors. It is noteworthy that none of the socioeconomic factors in Table 1 remained significant after adjustment for other factors using logistic regression. The risks of both stillbirth and early neonatal death were significantly increased by a history of prior stillbirth, premature delivery during the last pregnancy, low maternal weight ($\leq$45 kg), clinical anaemia, no antenatal visits, vaginal bleeding during pregnancy, elevated diastolic blood pressure, convulsions, antepartum haemorrhage, breech delivery, delivery by Caesarean section, and congenital malformations. For stillbirths, significant adjusted odds ratios were associated with a maternal age of 30–34 years, a prior child death, exposure to cooking smoke, and prolonged labour. Early neonatal death was strongly associated with asphyxia at birth. Other factors, such as changes in diet during pregnancy and the use of iron supplements, were not significant after adjustment using logistic regression. Attributable risks for stillbirth and early neonatal death were substantially increased for potentially preventable factors such as low maternal weight, anaemia, inadequate antenatal care and diastolic hypertension.

Discussion

The perinatal mortality rate of 79 per 1000 births is high, but not dissimilar to that reported in other Indian hospital-based studies (*9*). Although this may in part reflect the self-selection or referral of high-risk mothers to the study hospitals it is comparable to some population-based estimates (*11*). Perinatal mortality decreased exponentially with birth weight (Fig. 1)—a pattern similar to that observed in other countries (*7, 19*). The high relative risks for preterm and term low-birth-weight suggest that these are important determinants of perinatal mortality.

Analysis of the crude odds ratios showed that many factors were associated with an increased risk of perinatal mortality (Table 1). Since most of these factors are interrelated, a multivariate analysis was used to assess the independent effect of each variable (Table 2). All the socioeconomic variables became insignificant after being adjusted for other

Table 1: **Distribution of selected risk factors and unadjusted odds ratios for stillbirths and early neonatal deaths**

Category of risk factor	% of stillbirths (n = 451)	% of early neonatal deaths (n = 160)	% of controls (n = 1465)	Odds ratio: Stillbirths	Odds ratio: Early neonatal death
Socioeconomic					
No education	49.2	39.4	37.8	1.7[a]	1.4[a]
Low caste	53.2	43.1	44.1	2.3[a]	0.9
Husband works in farming	5.5	3.8	2.4	2.6[a]	3.9[a]
Migrant to city	14.2	9.4	4.8	3.4[a]	2.1[a]
No tap water in house	52.3	51.3	44.6	1.4[a]	1.3
No toilet in house	69.4	73.1	60.5	1.5[a]	1.8[a]
Maternal biological					
Age (years):					
30–34	16.4	7.5	10.4	1.9[a]	0.7
⩾35	7.1	1.9	2.2	3.9[a]	0.8
20–24 (referent)	42.8	53.1	51.0	1	1
Parity ⩾ 4	26.6	14.4	15.9	2.0[a]	0.9
Prior stillbirths	21.8	12.0	6.0	4.3[a]	2.1[a]
Prior child death:[b]					
1	19.8	22.0	16.8	1.4	1.4
⩾ 2	11.7	7.0	4.8	2.8[a]	1.6
Last birth premature	9.4	11.0	1.6	6.7[a]	7.6[a]
Interpregnancy interval ⩽ 6 months	10.4	15.0	8.2	1.7[a]	2.6[a]
Maternal weight:[c]					
⩽ 40 kg	22.4	23.1	11.6	3.1[a]	4.1[a]
41–45 kg	27.5	33.1	27.3	1.6[a]	2.5[a]
> 50 kg (referent)	18.6	14.3	29.5	1	1
Anaemia:[d]					
Moderate	28.4	29.4	13.0	2.9[a]	2.9[a]
Severe	6.0	3.1	0.4	19.3[a]	9.7[a]
Antenatal					
Antenatal care:[e]					
None	33.9	30.6	7.8	7.6[a]	7.9[a]
One visit	12.9	13.8	10.4	2.2[a]	2.6[a]
4–9 visits (referent)	25.1	21.9	43.9	1	1
Use of iron supplements:					
⩽ 1 week	48.8	53.1	19.9	5.2[a]	6.2[a]
2–4 weeks	19.1	16.9	21.0	1.9[a]	1.9[a]
5–12 weeks (referent)	22.2	20.0	46.6	1	1
Decreased dietary intake during last trimester	28.6	30.0	21.1	1.5[a]	1.5[a]
Problems in pregnancy:					
Oedema	22.2	6.9	13.4	2.1[a]	0.5
Vaginal bleeding	7.3	6.3	1.1	8.3[a]	6.0[a]
No complications (referent)	57.4	68.1	71.0	1	1
Exposure to cooking smoke	41.0	38.8	30.2	1.6[a]	1.5[a]
Use of tobacco	5.1	1.2	1.8	2.9[a]	0.7
Intrapartum					
Diastolic BP (mmHg)[f]					
100–119	16.9	6.9	8.3	2.6[a]	0.9
⩾ 120	8.2	3.8	0.5	21.7[a]	8.2[a]
< 90 (referent)	55.2	66.9	69.6	1	1
Problems on admission:					
Convulsions	3.8	3.8	0.1	38.7[a]	31.4[a]
Antepartum haemorrhage	8.0	5.6	0.3	32.8[a]	18.8[a]
No problem (referent)	23.9	29.4	33.6	1	1
Type of delivery:					
Breech	20.6	15.0	1.4	21.1[a]	14.7[a]
Caesarean section	8.0	11.9	3.0	3.9[a]	5.6[a]
Vertex (referent)	64.5	67.5	94.7	1	1
Prolonged/obstructed labour	2.9	2.5	0.7	4.1[a]	3.7[a]
Congenital malformation	8.4	6.9	0.2	44.7[a]	46.5[a]
Birth asphyxia	–	21.3	0.3	–	107.8[a]

[a] $P < 0.05$. [b–f] The following χ^2 values for trend were found: (see top of facing page).

Footnote	Stillbirths	Early neonatal death
b	18.5, $P < 0.0001$	2.7, $P = 0.099$
c	42.1, $P < 0.0001$	30.1, $P < 0.0001$
d	24.3, $P < 0.0001$	45.7, $P < 0.0001$
e	111.9, $P < 0.0001$	34.1, $P < 0.0001$
f	85.0, $P < 0.0001$	2.0, $P = 0.155$

Table 2: **Adjusted odds ratios and attributable risks for stillbirths and early neonatal deaths**[a]

Risk factor	Adjusted odds ratios: Stillbirth	Adjusted odds ratios: Early neonatal death	% prevalence of risk factors	Attributable risk percent: Stillbirth	Attributable risk percent: Early neonatal death
Maternal biological					
Age 30–34 years	2.1 (1.2–3.7)[b]	0.87 (0.3–2.4)	10.7	10.2	–
Previous stillbirth	3.1 (1.5–6.7)	3.5 (1.0–12.0)	3.9	7.7	8.8
> 1 previous child death	2.9 (1.2–6.9)	3.3 (0.7–15.4)	4.4	7.1	9.1
Last birth premature	11.3 (3.6–35.2)	5.3 (1.0–29.1)	0.7	6.7	2.6
Weight (kg):					
⩽ 40	3.7 (2.2–6.3)	3.2 (1.5–6.7)	11.9[c]	17.6	15.5
41–45	1.8 (1.2–2.9)	2.1 (1.1–4.2)	28.0[c]	12.8	18.8
46–50	1.9 (1.2–3.0)	1.3 (0.6–2.7)	29.8[c]	14.6	5.1
Anaemia:					
Moderate	2.3 (1.6–3.4)	2.3 (1.3–4.2)	11.6	12.0	12.9
Severe	11.6 (3.7–36.7)	4.5 (0.4–46.4)	0.9	7.7	2.7
Antenatal					
No antenatal care	2.7 (1.5–4.9)	3.9 (1.5–9.6)	8.0	10.4	14.2
Vaginal bleeding	12.8 (5.0–31.8)	14.0 (3.6–55.3)	0.7	7.1	8.6
Exposure to cooking smoke	1.5 (1.0–2.1)	–	10.9	4.7	–
Intrapartum					
Diastolic BP (mmHg):					
100–119	3.0 (1.9–4.9)	0.7 (0.3–2.3)	8.5[c]	12.4	–
⩾ 120	12.3 (4.3–35.1)	12.5 (2.2–69.9)	0.5[c]	4.4	5.7
Convulsions	6.4 (1.1–38.4)	45.7 (2.9–724)	1.1	4.2	31.7
Antepartum haemorrhage	32.4 (9.9–106.2)	39.2 (5.1–300.5)	0.5	11.0	12.3
Breech delivery	22.9 (12.5–41.9)	17.0 (7.0–40.1)	1.1	18.5	12.3
Caesarean section	2.1 (1.1–4.3)	5.3 (2.1–13.7)	5.8	5.0	17.7
Prolonged/obstructed labour	4.2 (1.1–16.3)	3.4 (0.3–34.3)	0.7	2.3	1.7
Congenital malformations	137.4 (33.0–573.0)	83.0 (16.9–408)	0.2[c]	21.4	8.3
Birth asphyxia	–	304.9 (78.7–1180)	0.3[a]	–	41.3

[a] The following variables were also included in the logistic regression models for stillbirth and early neonatal death: maternal education, caste, place of residence, toilet facilities, parity, interpregnancy interval, use of iron supplements, change in diet, presence of fetal membranes on admission, and sex of infant. For stillbirth the model also included referral, maternal occupation, and use of tobacco, while that for early neonatal death also included husband's occupation. None of these was significant.
[b] Figures in parentheses are 95% confidence intervals.
[c] The prevalence of exposure was derived from hospital controls since this variable was not included in the population survey.

variables that more directly measure maternal health status or conditions during the pregnancy and delivery. Thus, the effect of socioeconomic variables is probably mediated through other more proximate maternal biological, antenatal, and intrapartum factors, and in the study population, socioeconomic status appears not to have had significant independent effects on the risk of perinatal mortality. This is important because changes in socioeconomic status are generally not within the scope of the health sector, while modification of proximate factors, such as antenatal care or nutritional status, may be possible through health interventions. In the study the effects of socioeconomic status were perhaps partly diminished because the cases and controls were chosen only from public hospitals that cater mainly for the poor and lower middle class.

Low maternal weight and anaemia were associated with increased risk of both stillbirth and early neonatal death, and a study in Brazil has also reported increased risk of stillbirth and early neonatal death associated with low maternal weight (*7, 8*). Maternal weight was used as a measure of nutritional status rather than more complex measures of weight and height, because it is routinely recorded, easy to understand, and potentially modifiable. Separate measurements of pre-pregnancy weight and weight gain would have been desirable, but because the study was retrospective it was not possible to obtain such data reliably. In the study population, postpartum weight was a reasonable surrogate for pre-pregnancy weight, because for Indian women the total weight gain during pregnancy is relatively low (about 6 kg) and the net weight gain even smaller.[a] The substantial attributable risks associated with low maternal weight suggest that improvements in women's nutritional status may have a marked effect on perinatal mortality. Nutritional interventions should cover childhood and adolescence to achieve adequate pre-pregnancy weight and continue throughout pregnancy to ensure adequate weight gain.

Our findings of increased perinatal mortality risk associated with poor obstetric history are in accord with those of other workers (*6, 20*). Thus, although past obstetric history is important for screening high-risk mothers, the factors associated are not modifiable and can be used only as indicators of risk.

The total absence of antenatal care was associated with an increased risk of stillbirth and early neonatal death; and for those who had received some care, the risk increased as the number of visits decreased (Table 1). However, the odds ratios for no antenatal care decreased substantially after adjusting for other factors (Table 2), which suggests that the absence of such care may affect the risk of perinatal mortality by its association with other factors, such as complications during pregnancy and delivery. The association of lack of antenatal care with a high risk of perinatal mortality has been noted in previous studies (*6, 7, 21*). If it is assumed that this relationship is causative, substantial improvement in perinatal mortality can occur by enhancing coverage of antenatal care.

A history of vaginal bleeding during pregnancy was also associated with a substantially increased risk of stillbirth and early neonatal death, which is consistent with the findings of earlier investigations (*7, 22, 23*). Adjustment for other factors increased the odds ratio for bleeding, which suggests that its independent effect may be substantial. Since such vaginal bleeding cannot be prevented, it can only be used as a risk marker.

The association between exposure to cooking smoke during pregnancy and increased adjusted risk of stillbirth may have arisen by chance, and requires further investigation. However, it has been suggested that exposure to smoke from biomass fuels increases the level of carboxyhaemoglobin in maternal blood and may lead to deleterious effects on the fetus (*24, 25*).

During pregnancy, hypertension, eclampsia, and antepartum haemorrhage are risk factors for perinatal death (*4, 26*), and our results confirmed these findings. In view of the substantial attributable risk for these factors, their early detection and proper management may prevent many perinatal deaths.

The type of delivery was also an important predictor of risk of perinatal mortality. High risks (odds ratio = 17–22) were associated with breech delivery, which may be partly due to its association with preterm delivery. However, such high risk suggests that the management of breech delivery needs to be reviewed in the study hospitals. The higher risk associated with delivery by Caesarean section probably reflects underlying complications of pregnancy and delivery, but this needs further investigation to determine whether the risk can be reduced. A total of 29% of stillbirths died during labour, a considerably greater proportion than in developed countries (*27*). This could be due to late admission to hospital of high-risk cases and inadequate intrapartum management, and points to the need for better transportation of mothers in labour and efficient intrapartum management of high-risk cases.

[a] **Anderson, M.A.** *The relationship between maternal nutrition and child growth in rural India*. Doctoral thesis, Tufts University, 1989.

Some risk factors, such as birth asphyxia and prolonged labour, are identified only during parturition and cannot easily be predicted antenatally, thus highlighting the need for rapid access to emergency care during all deliveries.

The public health importance of any of the factors discussed here depends on their relative risk and prevalence in the community; the attributable risk percent combines both these into a single measure. Since the risk factor distribution among the controls was similar to that among the survey mothers who had delivered in government institutions, the results of the case–control study are generalizable to all deliveries in government institutions. Because these deliveries represent 51% of all births in Ahmedabad, and are mostly from the lower socioeconomic class, our results probably reflect the situation for the majority of the population, especially the most vulnerable groups. Low maternal weight, anaemia, lack of antenatal care, antepartum haemorrhage, and breech delivery had substantial attributable risks (> 10%) for both stillbirth and early neonatal death. However, some of the risk factors may be correlated with one another and the sum of attributable risks may exceed 100%, so that the potential effects of eliminating individual factors must be interpreted cautiously. Nevertheless, our findings suggest that improved maternal nutrition, as well as antenatal and intrapartum care, could have a marked impact on reducing perinatal deaths.

The approach we have described is especially suited to studies in developing countries. Poor maternal nutritional status, lack of antenatal care, and complications during pregnancy and delivery emerged as the major independent risk factors for perinatal mortality, most of which are amenable to intervention. There is therefore substantial scope for reducing perinatal mortality. Also, since socioeconomic factors probably act via these intermediate variables, it may be possible to improve perinatal survival, despite persistent, poor socioeconomic conditions.

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Résumé

Taux et facteurs de risque de mortalité périnatale, à Ahmedabad, Inde

Une surveillance et une étude cas-témoins de la mortalité périnatale a été effectuée dans trois grands hôpitaux universitaires de la ville d'Ahmedabad (Inde) parallèlement à une enquête par sondage chez des mères qui avaient accouché l'année précédente. Le but de l'étude était de mesurer le taux de mortalité périnatale, de quantifier ses facteurs de risque socio-économiques et médico-obstétricaux, et d'estimer quels étaient les principaux facteurs de risque attribuable dans la population, de façon à orienter les interventions préventives. Pendant la période de surveillance d'un an, 739 mortinatalités et 517 morts néonatales précoces ont eu lieu dans les hôpitaux de l'étude, ce qui donnait un taux de mortalité périnatale de 79 pour 1000 naissances. Des données détaillées ont été recueillies sur 563 (76,2%) mortinatalités et 222 (42,9%) morts néonatales précoces, en interrogeant les mères et en se basant sur les dossiers médicaux. Des données ont été également recueillies sur 1517 témoins, sélectionnés chez des enfants qui pesaient plus de 2,5 kg à la naissance et qui ont survécu à la période périnatale.

Les odds ratios bruts ont été calculés pour déterminer quelle était l'association entre la mortalité périnatale et les facteurs socio-économiques (niveau d'études, caste, religion, revenu, métier du mari, logement et installations sanitaires), les facteurs biologiques maternels (âge, parité, antécédents obstétricaux, poids, présence ou non d'anémie), les facteurs anténatals (soins anténatals, problèmes pendant la grossesse, changements alimentaires, emploi de suppléments de fer ou de vitamines, tabagisme et exposition à la fumée de feux de cuisson), et les facteurs intrapartum (tension artérielle, hémorragies et autres complications, type d'accouchement et complications du travail). Une série de modèles de régression logistique hiérarchique ont été utilisés pour calculer les odds ratios, corrigés des facteurs de risque les plus importants. Les résultats montrent que de mauvais antécédents obstétricaux, un faible poids maternel, une anémie clinique, l'absence de soins anténatals, une hypertension diastolique, des convulsions lors de l'accouchement, des hémorragies de l'antépartum, un accouchement anormal et des malformations congénitales sont d'importants facteurs de risque indépendants pour la mortinatalité et les morts néonatales précoces. L'exposition à la fumée de feux de cuisson était associée à un risque accru de mortinatalité. Des facteurs socio-économiques tels que le niveau d'études de la mère, la caste

et le type de logement ne restaient pas associés de façon significative avec les résultats après correction des facteurs maternels biologiques, anténatals et intrapartum.

L'enquête de population couvrait 1102 mères choisies par sondage en grappes en deux stades. Les données de l'enquête ont été utilisées pour mesurer la prévalence des facteurs de risque dans la communauté. Les informations obtenues ont été associées aux estimations du risque relatif obtenues à partir de l'étude cas-témoins, pour calculer le pourcentage de risque attribuable dans la population en ce qui concerne les facteurs de risque les plus importants. Le risque attribuable était élevé (>10%) pour un poids maternel faible (<46 kg), l'anémie, l'absence de soins anténatals, les hémorragies de l'antépartum, l'accouchement par le siège et les malformations congénitales. Le risque attribuable pour les morts néonatales précoces était également élevé pour les convulsions et l'asphyxie à la naissance.

Au total, les résultats laissent à penser que l'amélioration de la nutrition maternelle, des soins anténatals et de la prise en charge de l'intrapartum pourrait avoir des conséquences importantes sur la mortalité périnatale, malgré l'existence de conditions socio-économiques défavorables.

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