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Maternal nutritional status & practices & perinatal, neonatal mortality in rural Andhra Pradesh, India

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***Background & objectives*: Despite a vast network of primary health centres and sub-centres, health care outreach in rural parts of India is poor. The Dangoria Charitable Trust (DCT), Hyderabad, has developed a model of health care outreach through trained Village Health and Nutrition Entrepreneur and Mobilisers (HNEMs) in five villages of Medak district in Andhra Pradesh, not serviced by the Integrated Child Development Scheme (ICDS) of the Government of India. Impact of such a link worker on perinatal/ neonatal mortality has been positive. The present study attempts to examine the association of maternal nutrition and related factors with perinatal, and neonatal mortality in these villages.**

***Methods*: Women from five selected villages who had delivered between June 1998 and September 2003, were identified. Those who had lost a child before one month (28 days), including stillbirths, (group 1- mortality group), who could be contacted and were willing to participate, were compared with those who had not lost a child (group II- no mortality), through a structured questionnaire and physical examination for anthropometric status and signs and symptoms of nutritional deficiency. Categorical data were analysed using Pearson chi square analysis. Continuous data were analysed using Student's t test.**

***Results*: Mortality during perinatal, neonatal period was 8.2 per cent of all births. Malnutrition was rampant. Over 90 per cent women had 3 or more antenatal check-ups, had taken tetanus injections and had complied with regular consumption of iron-folic acid tablets. Higher percentage of women in group I (mortality group) tended to have height less than 145 cm (high risk) and signs and symptoms of micronutrient deficiencies. However, differences between groups I and II were not statistically significant. Pre-term delivery, difficult labour (use of forceps), first parity, birth asphyxia (no cry at birth) and day of initiating breastfeeding showed significant association with mortality.**

***Interpretation & conclusion*: Significant association between signs and symptoms of malnutrition with perinatal, neonatal deaths may have been masked by high prevalence of malnutrition in the mothers of both the groups and the small study sample size. However, maternal malnutrition, may contribute indirectly through its effects on other pregnancy-related as well as delivery-related complications leading to adverse outcome of pregnancy. The HNEM experience of DCT suggests that a properly trained and supported village level worker can contribute to reduction in perinatal and neonatal mortality.**

Key words Maternal malnutrition - neonatal death - perinatal mortality

Despite economic development, India continues to have high incidence of infant and childhood mortality and malnutrition. Perinatal deaths (stillbirths and deaths within 7 days of birth) contribute to over 80 per cent of neonatal deaths (infant deaths within 28 days of birth)[1-3]. The reasons for this are complicated, but primarily point to neglect of female health and nutrition, lack of skilled assistance during delivery, and poor neonatal care. Despite a vast network of government - run primary health centres (PHCs) and sub-centres, health care outreach in rural India is poor. Our surveys showed that most people consult private doctors and hospitals for health problems including obstetric, gynaecological problems[1-3]. Even where there is a good compliance with antenatal check-ups, over 50 per cent deliveries in rural India are conducted at home, mainly for reasons of affordability. The Dangoria Charitable Trust (DCT), Hyderabad, has developed a model of primary health care delivery through trained women Health and Nutrition Entrepreneur and Mobilisers (HNEMs) in 5 villages[1,2] of the Narsapur *mandal* of the Medak district of Andhra Pradesh which are not serviced by the Government of India's Integrated Child Development Scheme (ICDS). This programme, which was started in June 1998, has provided an opportunity to gain insight into the association of maternal nutritional and related factors, and practices and the resistant problem of high perinatal/neonatal mortality to plan future affirmative strategies. Details regarding selection of subjects, training of HNEMs and the community's acceptance of this link worker have been published elsewhere[2]. The aim of the present study was to examine the association of maternal nutrition and related factors with perinatal and neonatal mortality in these five villages of Andhra Pradesh.

Material & Methods

The study area included five villages from Narsapur *mandal* of Medak district (population 4400) with poor health care outreach since they were not serviced by the ICDS scheme (Table I). Most neighbourhood bigger villages were serviced by the ICDS and hence were not selected. As reported earlier[2] the HNEMs received intensive training for two months in theoretical and practical aspects of health, hygiene and nutrition, common illnesses and identification of at-risk cases of pregnancy and other common ailments for referral.

Women from the five study villages, who had delivered a child (regardless of the outcome) during the period June 1998 and June 2003, were identified through the birth and death records maintained by the HNEMs. Relevant data on mothers who could be contacted and were willing to participate in the study, were collected, through home visits, by using a pre-tested, structured questionnaire and physical examination, in two phases. The questionnaire was prepared in consultation with gynaecologists, paediatricians and nutrition/public health scientists and pre-tested on some mothers from the same community.

All mothers who had delivered during the stated time period could not be contacted for inclusion in this study since many had migrated from the village to another village (mother's home to in-law's home). Besides, some mothers were unwilling to spare the time needed to answer the questions and physical examination. Thus only about 70 per cent of the mothers could be included, and this, was the major constraint of the study leading to small sample size. Mothers who had delivered between June 1998 and May 2001, and

Table I. Village-wise sampling in the five study villages

Village	Total population	Number of births: Period A- June 1998-May 2001		Period B- June 2001-June 2003		Overall	
		Group		Group		Group	
		I	II	I	II	I	II
Avancha	1072	7	60	4	50	11	110
Gollapally	622	0	33	0	27	0	60
Madapur	563	2	23	2	13	4	36
Narayanpur	1029	4	28	3	12	7	40
Ramchandrapur	1071	6	53	3	50	9	103
Total	4357	19	197	12	152	31	349

I-mortality group, II-no mortality group

who could be contacted and were willing (197 mothers, 216 births) (period A) were examined retrospectively during April-May 2001 when the study was conceived. Subsequently, 164 mothers who had delivered between June 2001- June 2003, (period B), who could be contacted and were willing, were examined within 1-2 months after delivery.

The dependent variable was death within the first month of life, including stillbirths. The independent variables were: place of birth (village or institution), birth attendant (doctor, nurse or, traditional birth attendant), type of delivery (normal, forceps or caesarean), day of initiation of breastfeeding, administration of other fluids, sex of the child, birth weight, age of the mother, number of antenatal check-ups done, duration of gestation, parity, birth spacing, labour-intensive work till the end of gestation, history of alcohol consumption, tobacco chewing or smoking and mothers' nutritional status as judged by height, weight, mid arm circumference, signs of iron deficiency anaemia (pallor of nails, tongue and conjunctiva, and feeling of tiredness), signs of vitamin A deficiency (night blindness, Bitot spots), and signs of B complex vitamin deficiency (angular stomatitis and glossitis). Birth weight could be recorded only for about 54 per cent babies who were born in the study villages or in Dangoria Charitable Trust hospital. Other hospitals in the villages including the government hospitals did not record birth weight during the study period.

Since most mothers in rural India do not know their age, only estimates of age could be obtained by querying the mothers about the years after menarche when co-habitation with husband occurred (child marriages are very rare), and years after this that the child was born. This information can be elicited with reasonable certainty. Age at menarche was assumed to be 14 yr.

Since most mothers were illiterate, written consent could not be obtained, but the mothers were explained the purpose of the study, and only those who were willing were included. Approval for the study (including *ethical approval*) was obtained from the Board of Trustees of the Dangoria Charitable Trust and from the Monash University Standing Committee on Ethics in research on humans.

Statistical analysis: Data were analysed using SPSS 14.0 Windows version statistical software. Frequency tables and cross tabulation for different parameters were generated. Categorical data were analysed using Pearson's chi square test to see any association between groups. Z-test for the difference in proportions was used to see two proportions are statistically significant or not. $P<0.05$ was considered significant. Due to small and unequal sample size in the two groups, logistic regression analysis could not be done.

Stillbirths and neonatal deaths were pooled together as group I (mortality group). All other births were classified as group II (no mortality group). Perinatal and neonatal deaths can be grouped together when considering interventions due to their similar array of risk factors[4].

Results

During period A (June 1998 to May 2001) 197 mothers had given birth to 216 infants, of whom there were 19 perinatal/neonatal deaths (7 stillbirths and 12 neonatal deaths-8.8%). In period B, (May 2001 to June 2003) 164 mothers had delivered of whom there were 12 neonatal deaths, including 7 on the first day (7.3%).

In period A where the gap between birth of the child and initiation of the study was large, 20 (26.3%) mothers in group I (mortality group) and 15 (7.6%) mothers in group II (no mortality group) were pregnant at the time of examination. While in this period only 15.8 per cent mothers in group I were lactating beyond eight months, 51.8 per cent mothers in group II were lactating beyond 8 months. The difference between groups in the current physiological status of the mothers was significant. In period B such differences between groups in the current physiological status of the mother was not a problem since the mothers were examined within a month or two after delivering the index child.

Among the putative independent variables, statistically significant difference between groups I (mortality group) and II (no mortality group) was observed with regard to duration of gestation (pre-term births), type of delivery, cry at birth (birth asphyxia), first parity and initiation of breastfeeding on day 1 (Tables II-V). Maternal nutrition status showed some trends but group means were not significantly different except proportion of mothers with one or more signs of vitamin A deficiency (Table VI).

Age of the mother: Only 8.1 per cent mothers were under the age of 18, and 1.3 per cent above the age of 35. Difference between groups I and II was not significant.

Place of delivery: In period A, 57.8 per cent deliveries were institutional (government or private hospital, or PHC). In period B the institutional deliveries had increased to 64.6 per cent.

Difference between periods A and B was not significant. Also, the difference between group I and II in terms of institutional deliveries was not significant perhaps due to small sample size and the possibility that more difficult cases and primi deliveries tend to go to hospitals or health care centres for deliveries. Thus while 81.6 per cent deliveries for first parity were institutional, only 55.3 per cent for later parities were institutional deliveries. The difference however was not statistically significant.

Duration of gestation: Almost 7 per cent births were pre-term. Significantly more deaths occurred in infants born pre-term (Table II).

Type of delivery: The type of delivery significantly influenced the outcome of pregnancy (Table III). Almost 88 per cent deliveries were normal. In group I, the percentage of forceps cases tended to be higher.

Table II. Comparison of duration of gestation-comparison between groups I & II

% of births

Parameter	Period A- June 1998-May 2001 Group		Period B- June 2001-June 2003 I & II Group		Overall (% women) Group	
	I	II	I	II	I	II
Number of births	19	197	12	150	31	347
Term delivery	52.6	98.0	58.3	93.3	54.8	96.0
Pre-term delivery	47.4	2.0	41.7	5.3	45.2	3.5
Post-term	0	0	0	1.3	0	0.5
P <	0.001		0.001			

I- Mortality group, II- No mortality group

Table III. Comparison type of delivery-comparison between groups I & II

% births

Parameter	Period A- June 1998-May 2001 (%women) Group		Period B- June 2001-June 2003 (%women) Group		Overall (%women) Group	
	I	II	I	II	I	II
Number of births	19	197	12	152	31	349
Normal delivery	78.9	88.6	83.3	87.5	80.6	88.2
Forceps delivery	15.8	1.6	16.7	0.7	16.1	1.1
Caesarian delivery	5.3	9.8	Nil	11.9	3.2	10.6
P	*P* < 0.001		*P* <0.001		*P*<001	

I - Mortality group, II -No mortality group

Table IV. Comparison of cry at birth between groups I & II

% of births

Parameter	Period A- June 1998-May 2001 (% women) Group		Period B- June 2001-June 2003 (% women) Group		Overall (% women) Group	
	I	II	I	II	I	II
Number of live births	12*	197	12	152	24	349
No cry at birth	33.3	3.5	41.7	4.6	37.5	4.0
P <	0.001		0.001		0.001	

I-Mortality group, II-No mortality group, *Excludes 7 stillborn babies

Table V. Comparison of initiating breast-feeding between groups

% of births

Parameter	Period A- June 1998-May 2001 (%women) Group		Period B- June 2001-June 2003 (% women) Group		Overall (% women) Group	
	I	II	I	II	I	II
Number of infants who survived beyond the first day	12[@]	197	5*	152	17	349
Breastfeeding						
Day1	33.3	65.5	Nil	73.0	23.5	68.8
Day2	0	9.1	20.0	13.2	5.9	10.9
Day≥3	66.7	25.4	80.0	13.8	70.6	20.3
P<	0.001		0.001		0.001	

[@] Excludes 7 stillborn babies, * Excludes 7 children who died on day[1]
I - Mortality group, II -No mortality group

No cry at birth: Significantly higher percentage of live born babies in group I than group II failed to cry at birth, suggesting that birth asphyxia was an important cause of mortality (Table IV).

Day of starting breastfeeding: Over 60 per cent mothers had started feeding their baby from day 1. (Table V). The percentage of mothers who delayed initiating breastfeeding till day 3 was significantly higher in the mortality group (group I). In period A, 7 children were stillborn and hence not included. In period B, 7 children died on day 1 and perhaps could not be breastfed. Over 20 per cent mothers had given pre-lacteal food – mostly sugar water, and honey.

Parity: Overall, higher percentage of deliveries in group I (54.8%) than in group II (34.1%) were first parity, the difference being significant ($P<0.05$).

Birth spacing of less than 24 months: In period A there were 144 multi-para births, of which 47.9 per cent had birth spacing less than 24 months. In period B there were l04 multi-para deliveries. Of these, 41 per cent had birth spacing less than 24 months. Between groups differences were not significant.

Birth weight: Birth weight could be recorded for only 110 (50.9%) babies in period A and 97 (59.1%) babies in period B. Mean birth weight in both the periods was 2.5 (SD 0.5). Overall, 22 per cent babies were born with birth weight less than 2.5 kg (low birth weight). However, 23.5 per cent babies had birth weight of exactly 2.5 kg. Due to small sample size, between groups (I and II) comparison was not tested, especially since, due to cultural reasons birth weight could not be recorded for still born babies and those who died on day 1.

Antenatal check-ups done: Overall more than 90 per cent mothers had undergone more than 3 antenatal check-ups. However, in the first period (period A) only 73.7 per cent mothers in group I compared to 92.4 per cent in group II had undergone more than 3 antenatal check-ups but the difference between groups missed significance ($P<0.054$). This suggested that the frequency of antenatal check-up was an important factor. In the second period (period B), 92 per cent mothers in both the groups had undergone more than 3 antenatal check-ups.

Compliance with regular intake of iron-folic acid tablets: Almost 90 per cent mothers in both the groups at both the time periods had complied with regular intake of iron-folic acid tablets and had received tetanus injections.

Malnutrition in mothers: Over 60 per cent mothers (pre-gravid state) suffered from chronic energy deficiency as judged by body mass index (weight/height^2) less than 18.5. (Table VI). No difference between the groups I and II was apparent. Neither the mean height nor mean weight differed significantly between the groups. However, higher percentage of women in group I than group II tended to have height less than 145 cm regarded to be at risk (Table VI). The difference was significant only in period A ($P<0.05$). About 38 per cent mothers in both the groups had body weight less than 38 kg and were at high risk.

Anaemia: Over 50 per cent mothers had one or more signs and symptoms of anaemia (Table VI). Higher

Table VI. Nutritional deficiency signs and symptoms (comparison between groups)

Parameter	Period A- June 1998-May 2001 (% women) Group		Period B- June 2001-June 2003 (% women) Group		Overall (% women) Groups	
	I	II	I	II	I	II
Number of births	19	197	12	152	31	349
Height cm (Mean±SD)	149.4 ±4.89	150.6 ±4.79	151.4 ±6.4	150.8 ±5.2	150.2 ±5.5	150.7 ±4.97
Height < 145 cm %	26.3	12.2*	8.3	10.5	19.4	11.5
Weight (kg) non-gravid women (Mean±SD)	40.13 ±2.20	41.07 ±6.72	40.0 ± 4.0	41.9 ±6.5	40.1 ±2.96	41.5 ±6.62
Mean body mass index (BMI) (Mean±SD)	18.3 ± 1.42	18.3 ±2.42	17.5 ±1.93	18.4 ±2.41	18.0 ±1.65	18.35 ±2.41
BMI (< 18.5) %	52.6	66.0	66.0	57.0	57.8	62.0
Weight (non gravid women) <40 kg	40.0	44.1	50.0	35.8	38.7	38.1
MAC (Mean±SD)	23.45 ±1.11	23.64 ±2.06	22.6 ±1.72	22.9 ±2.65	23.1 ±1.41	23.3 ±2.36
Anaemia- signs of pallor	68.4	53.8	50.0	45.4	61.3	50.1
Anaemia - Feeling of tiredness	47.4	36.5	66.7	46.1	54.9	40.7
At least one sign of anaemia	78.9	67.0	83.3	65.8	87	66.5*
Vit.A def. (Bitot's spots)	0	4	8.3	0.7	3.2	1.4
Vit.A def. (Current night blindness)	5.3	2.5	0.7	0	6.4	1.4
Current- any one sign of vitamin A deficiency	15.7	17.2	8.3	1.4	13.0	10.0
Night blindness during pregnancy	10.5	13.2	16.7	12.0	12.9	13.2
B vitamin deficiency-angular stomatitis	5.3	3.0	0	4.6	3.2	3.7

*P < 0.05, Group I, Mortality, Group II, No mortality
MAC-mid arm circumference

percentage of mothers in group I, had evidence of anaemia as judged by any one of the signs and symptoms- pallor and/or feeling of tiredness. Unfortunately, measurement of haemoglobin could not be done for practical reasons, including women's reluctance to give finger prick blood. However, pallor of conjunctiva and tongue has been used to detect anaemia among Indian women in earlier studies[5].

Vitamin A deficiency signs and symptoms: Higher percentage of mothers in group I showed Bitot's spots (3.2%) compared to group II mothers (1.4%) . However, the difference between groups was not significant. Almost 13 per cent mothers reported suffering from transient night blindness during pregnancy**.** At the time of examination only 6.4 per cent mothers in group I, and 1.4 per cent in group II complained of night blindness (Table VI).

B-complex vitamins deficiency: Over 3 per cent mothers had oral lesions like angular stomatitis and glossitis suggestive of B-complex vitamins deficiency with no difference between groups I and II (Table VI).

Drinking habit, and use of drugs for treatment: Over 80 per cent mothers drank toddy (palm juice, adulterated with diazepam and chloral hydrate) occasionally or daily, the percentage of occasional drinkers being higher in period B (65.9%) than period A (25.9%). None of the mothers smoked or took hard drugs. However in period A few mothers in group I reported taking some Ayurvedic (Indian system of medicine) drug for treatment.

Type of occupation, help with housework, and heavy work till labour: For 80 per cent mothers, farming was the major occupation. Most received help with housework during pregnancy**.** While 46.8 per cent mothers in period A reported working till the end of gestation, this percentage was only 14.6 per cent in period B, the difference being significant (P<0.01), perhaps due to advise from HNEM and project staff.

Discussion

In the current study an effort was made to examine a range of putative parameters associated with perinatal, neonatal mortality, which may have direct or indirect relationship with maternal nutrition. Some important non nutritional parameters of obstetric management were also examined. Despite small sample size, some interesting findings emerged. Parameters like mothers' age, parity, and place of delivery (village or institutional) did not reveal any association with mortality. First parity, pre-term birth, type of delivery (forceps), no cry at birth (birth asphyxia) and delay in initiation of breast-feeding emerged as significant risk factors for perinatal and neonatal mortality.

Though the differences between groups on anthropometric parameters and the signs and symptoms of micronutrient deficiencies were statistically not significant - perhaps due to rampant malnutrition, and small sample size, higher percentage of the mothers in group I than group II tended to have height lower than 145 cm which is regarded to be high risk. Also, the percentage of mothers with pallor and feeling of tiredness suggestive of iron-deficiency anaemia and evidence of vitamin A deficiency was higher in group I.

The degree of malnutrition observed in this study compares well with the data of the National Nutrition Monitoring Bureau for the State of Andhra Pradesh in India[6], except slightly lower mean weight observed in this study. This may be due to the fact that the villages included in this study belong to a more backward (Telangana) area of the State.

Breastfeeding is delayed till 3 days in the belief that colostrum is dirty, and inadequate to meet the infant's need, and complimentary feeding is delayed till one year[1,2]. Association between early neonatal mortality and initiation of lactation has been documented[4]. Premature infants may not get breast feed because they are too small and may be sick and cannot suckle. Feeding of inadequate and contaminated pre-lacteal feeds can also result in illness and death in the neonatal period.

Despite economic constraints, there is scope for improving maternal and child nutrition through nutrition education and better caring for the females. A positive impact of the educational inputs of the HNEM programme of DCT on mothers' knowledge and some practices has been reported[2]. The average birth weight (2.7 kg) in the present cohort was comparable to the national average[7]. The incidence of low birth weight (23%) is also comparable to the national average[3]. However, for almost equal percentage of babies the birth weight recorded was 2.5 kg suggesting borderline normal.

Globally the main direct causes of neonatal deaths are estimated to be pre-term births (28%), severe infections (26%), and asphyxia (23%)[8]. In the present investigations, pre-term birth and birth asphyxia both showed positive association with mortality. Estimate of infections could not be obtained, but when asked, no mother reported tetanus or diarrhoea which used to be major killers in the past, to be the cause of death of their infant. Some of them mentioned vomiting. About 17 per cent mothers mentioned jaundice or respiratory infections. Malnutrition during pregnancy and lactation increases the risk of maternal infections and impairs the development of the foetal immune system[4]. Birth asphyxia is not surprising since untrained birth attendants without the necessary wherewithal or training are not able to resuscitate asphyxiated infants. Training traditional birth attendants and hospital staff in revival of asphyxiated babies by using an Ambu bag would be an affirmative intervention.

Stunting of mothers due to malnutrition, and consequent cephalo-pelvic disproportion (CPD), increases the risk of delivery related complications[9]. Stunted mothers are at high risk and should be advised institutional delivery where facilities for caesarean section are available. Rural primary health centres do not have such facilities. Application of forceps by relatively inexperienced nurses or doctors can lead to mortality. Institutional delivery should be insisted for the first delivery. Government PHCs and hospitals, which are free, should be strengthened and should be more patient friendly, so that women readily utilize their services.

In the present study all mothers who had delivered during the study period could not be contacted. However, total birth and death records in these five villages for the study period maintained by the HNEMs showed, remarkable decline in perinatal death rate from 124 between June 1998 to March 1999, to 14 during April 2006 to March 2007, and neonatal death rate from 70 to 14 in the same period[3,10]. Thus, our findings show that despite enormous constraints that operate in developing countries like India, reduction in perinatal and neonatal deaths can be achieved through properly trained village health link workers and traditional birth attendants. In this regard the ASHA (Accredited Social Health Activist) scheme suggested by the National Rural Health Mission, assumes importance.

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