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Burden of Morbidities and the Unmet Need for Health Care in Rural Neonates - A Prospective Observational Study in Gadchiroli, India

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Background: Majority of the neonates in developing countries are born and cared for in rural homes but the available information is mostly hospital based. Objectives: To estimate: (i) the incidence of various neonatal morbidities and associated case fatality in home-cared rural neonates, (ii) proportion of neonates with indications for health care, and (iii) the proportion who actually receive it. Design: Prospective observational study. Setting: Rural homes. Methods: Neonates in 39 study villages in the Gadchiroli district (Maharashtra, India) were observed during one year (1995-96) by 39 trained female village health workers at birth and during neonatal period (0-28 days) by making eight home visits. A physician checked the data and the morbidities were diagnosed by a computer program. Vital statistics in these villages was independently collected. Results: Out of 1016 live births, 95% occurred at home and 763 (75%) neonates were observed. The agreement between observations by health workers and physician was 92%. Total 48.2% neonates suffered high risk morbidities (associated case fatality >10%), 72.2% suffered low risk morbidities, and 17.9% gained inadequate weight (<300g). Seventeen percent neonates developed clinical picture suggestive of sepsis. Though 54.4% neonates had indications for health care and 38 out of total 40 neonatal deaths occurred in these, only 2.6% received medical attention. The neonatal mortality rate was 52.4/1000 live births. Conclusion: Nearly half of the neonates in rural homes developed high risk morbidities ten times the neonatal morbidity rate and needed health care but practically none received it. The magnitude of care gap suggests an urgent need for developing home-based neonatal care to reduce neonatal morbidities and mortality.

Key words: *Health Care, Morbidity, Neonates, Rural, Sepsis.*

With five million neonatal deaths occurring each year, neonatal mortality accounts for nearly half of the global child mortality (1,2). Sixty three per cent newborns in developing countries and 83% in rural India are born at home(2,3). Even those born in hospital are usually discharged soon after birth. Since hospital care is usually inaccessible, most neonates in rural areas are cared, and survive or die, at home.

In such situation, a realstic planning of neonatal health care requires community-based estimates of the burden of neonatal morbidities and the care gap. These data were not available. Most studies estimated a single morbidity such as asphyxia or sepsis(4,5) and studies were most often hospital based(6-8). The situation of neonatal health in rural

homes can not be extrapolated from the hospital-based studies because the conditions are radically different. Moreover, only selected neonates reach hospitals.

A few studies on birth asphyxia were community based(4,9) but the incidence was estimated by retrospective inquiry which could yield wrong information. Most studies on birth weight were hospital-based; and in the few conducted in community, the birth weight was not measured on the first day, but on the day of visit of the health worker(9). All studies on the incidence and outcome of neonatal sepsis were hospital based(5,6,10). Thus, the available information may not represent the true picture of neonatal health in rural homes. We, therefore, prospectively observed home-cared neonates in rural area to estimate: (*i*) incidence of various neonatal morbidities and associated case fatality; (*ii*) proportion of neonates with indications for health care; and (*iii*) proportion who actually received it.

Subjects and Methods

The Study Area: The study was conducted in the Gadchiroli district (Maharashtra State), situated in the central part of India, by SEARCH (Society for Education, Action, and Research in Community Health). The study area, the available health care and selection of 39 study villages have been earlier reported in detail(11). The vital statistics was regularly collected and pneumonia in children was managed by the male village health workers and traditional birth attendants (TBAs) trained by SEARCH(12), in these 39 villages. Community consent for conducting a study on neonatal health was obtained and village women with five to ten years of education were selected in 39 villages as female Village Health Workers (VHWs) for studying the neonates.

These 39 villages formed the intervention area in the field trial of neonatal care(11). The first year (1995-96) was devoted primarily to observing neonatal health with minimum interventions. The present study is an outcome of this observation period.

Traditional Neonatal Care was studied by a female social worker who inquired from the TBAs, grandmothers and mothers using unstructured interviews; and observed the neonatal care at homes.

Training and Data Collection: First, we listed the neonatal morbidities to be studied, the related maternal and environmental variables, and the neonatal signs/symptoms. Then we trained the 39 newly selected female VHWs to take history, observe the process of labor, examine newborns, and record the findings. We repeatedly assessed their knowledge and skills till a satisfactory level was reached. Each female VHW collected data on mothers and neonates in her own village by making 3 visits during pregnancy, attending labor and making 8 home visits on fixed days during 0-28 days, and more if necessary. The methods have been earlier reported(11). The VHWs were also trained to provide case management of pneumonia in children, including in neonates(12).

The newborns received care from family and TBA but also from government nurse or private doctor if the family invited them. The family was free to take baby to hospital. Care received and the sources were recorded by female VHWs.

Female VHWs followed the newborn till the 28th day, or death, or till the mother and the baby left the village, whichever was earlier. Every attempt was made to collect the data completely. However, many women move to parents' house for delivery, and go back to their husbands' village after delivery; some such pregnant women or their deliveries were either missed or visited late by VHWs. If the mother and baby left the village before 28th day, the observation of the newborn remained incomplete. The data were collected from 1st April 1995 to 31st March 1996.

Supervision, Quality Control and Ethical Aspects: A physician visited each village once in two weeks and verified the data recorded by VHWs. To assess the quality of data collected by VHWs, the physician indepen-dently recorded parallel observations on 119 consecutive neonates. Comparison of data on selected 46 test variables showed agreement ranging from 70.2 to 100%, mean agreement was 92.7% (SD 6.7).

Since the algorithm for managing seriously sick neonates at home was not available and since the ethical clearance for such home-based management had not been obtained in the first year (1995-96) of the field trial, no aggressive treatment at home was provided by the physician apart from what was already being provided by the TBAs. If he found a newborn seriously sick, the family was advised to hospitalize the baby; SEARCH offered to provide the ambulance service for transporting the sick baby; but the final decision was left to the family.

An external group of neonatologists and pediatricians reviewed the study design, diagnostic criteria, training of VHWs, and data collection at the beginning and at the end of the study to ensure good quality and the ethical aspects (see acknowledgement).

Diagnosis of Health Problems: Simplified diagnostic criteria were finalized *(Appendix 1)* from the recommendations of the National Neonatology Forum, India(13). The records were so designed as to collect the clinical information necessary to apply these criteria. A computer program was prepared to diagnose various neonatal morbidities using these criteria. The completed neonatal records were weekly reviewed and the diagnoses were made independently by the physician, statistician and the computer program - all using the same set of criteria. In the event of differences, the original record was reviewed together. If necessary, the record was sent back to the village for the necessary clarification and finally a unanimous decision was reached.

Since the diagnoses were entirely clinical, we clubbed septicemia, meningitis and pneumonia together as 'sepsis'. Hypothermia was defined as skin temperature less than 95°F because we found that case fatality signi-ficantly increased below 95°F .

Indications for Health Care: We decided that the presence of any 'high risk' health problem (those associated with case fatality >10%) or inadequate weight gain (<300 g; the choice of this cut off point is explained later on) during neonatal period indicated need for health care. Neonatal health problems associated with case fatality <10% were called 'low risk'.

The vital statistics in the study villages was collected independently by male VHWs and their supervisors by way of prospective reporting and six monthly cross surveys with financial incentives for detecting births and child deaths(11,12).

Statistical Analysis was done by using SPSS-PC. Chi square test with Yate's correction was used as the test of significance.

Table I - *Maturity and Birth Weight of the Home-Cared Neonates and Associated Case Fatality (n=763)*

	Birth weight (g)						
	<1500	1500-1999	2000-2499	>2500	Weight unknown	Total	
Gestation*	Deaths/ neonates	Deaths/ neonates	Deaths/ neonates	Deaths/ neonates	Deaths/ neonates	Deaths/ neonates	% Incidence#
(Completed wks)	(%C.F.$)	(%C.F.$)	(%C.F.$)	(%C.F.$)	(%C.F.$)	(%C.F.$)	
<37	8/11 (72.7)	12/23 (52.2)	5/28 (17.9)	0/10 (0.0)	0/3 (0.0)	25/75 (33.3)	9.8
37- 38	1/2 (50.0)	4/16 (25.0)	3/79 (3.8)	0/93 (0.0)	3/10 (30.0)	11/200 (5.5)	26.2
>=39	0/0 (0.0)	2/21 (9.5)	1/135 (0.7)	0/307 (0.0)	0/10 (0.0)	3/473 (0.6)	62
Gestation unknown	0/0 (0.0)	0/1 (0.0)	0/4 (0.0)	1/7 (14.3)	0/3 (0.0)	1/15 (6.7)	2
Total deaths/ neonates (% C.F.$)	**9/13 (69.2)**	**18/61 (29.5)**	**9/246 (3.7)**	**1/417 (0.2)**	**3/26 (11.5)**	**40/763 (5.2)**	**-**
%	**1.7**	**8**	**32.2**	**54.7**	**3.4**	**100**	**100**

Incidence #

* Period of gestation was estimated from the last date of menstruation.
# % Incidence out of 763 neonates.
$ % Case fatality of each cell.

Table II - *Incidence of High Risk Health Problems, Associated Fatality, and Relative Risk of Death in Home Cared Neonates (n = 763)*

High-Risk® health problems♠	Sick neonates (0-28 days)		Deaths ⊕		Relative risk of death
	No.	Incidence(%)	No.	Case fatality (%)	
Congenital anomaly	10	1.3	2	20.0	4.0
Multiple pregnancy	22	2.9	8	36.4	8.4
Birth asphyxia					
Severe	26/570#	4.6	10	38.5	8.0
Indirect	3/193	1.6	2	66.7	13.9
Preterm	75	9.8	25	33.3	15.3
Birth weight<2000 g.	74	9.7	27	36.5	19.3
Neonatal sepsis (clinical)	130	17.0	24	18.5	7.3
Only pneumoniaÏ	8	1.0	0	-	-
Delayed breastfeeding	71	9.3	8	11.3	2.4
Problems in breastfeeding					
Baby unable to suck	67	8.8	10	14.9	8.0
Both mother and baby had problems	57	7.5	18	31.6	16.8
Total	124	16.3	28	22.6	12.0
Meconium aspiration	4	0.5	4	100.0	21.1
Hyaline membrane disease	4	0.5	4	100.0	21.1
Hypothermia (<95ºF)	130	17.0	20	15.4	4.9
Hemorrhage	11	1.4	8	72.7	17.1
Abnormal jaundice	13	1.7	3	23.1	4.7
Neonates with any one of the high risk health problems (95% CI)	**368**	**48.2 (44.7 - 51.7)**	**38**	**10.3 (7.2 - 13.4)**	**20.4 (5.0 - 83.9)**

® High Risk = case fatality >10%.

♠ Diagnostic criteria = see Appendix 1.

⊕ Most deaths occurred in neonates with multiple problems. Such deaths were included with more than one health problem. Thus, associated % case fatality shown here does not imply that death was entirely attributable to that problem.

Actual observations at birth were made by VHWs on 570 neonates.

♣ 55 cases out of 130 were treated with co-trimoxazole, because they fulfilled the criteria of pneumonia as well.

∉ Respiratory rate > 60, but no other sign of sepsis present. All the cases received treatment with co-trimoxazole. Hence, included in high-risk category inspite of no fatality.

Results

Study Population and Completeness of Observations: The socio-demographic features of the 39 study villages have been reported earlier(11). A total of 1016 live births were reported in the 39 villages in one

year. Estimation by Chandrasekar-Demming method(14) revealed that this birth reporting was 99.5% complete. Out of these, 763 (75.1%) neonates were studied by female VHWs, and 253 were not studied for the reasons mentioned earlier. Fifty two neonatal deaths occurred in the study area, 40 among the 763 neonates studied and 12 among the 253 neonates not studied. Neonatal Mortality Rate (NMR) per 1000 live births in the studied group was 52.4 and in the unstudied group it was 47.4 ($p = 0.88$). Hereafter, the 763 observed neonates constitute the study population. Infant mortality rate (IMR) in the study villages during 1995-96 was 73/1000 live births.

Number of neonates on whom observation had started by different time were as follows (cumulative per cent in parenthesis): during labor 570 (74.7%), within six hours after birth 705 (92.4%), by the third day 725 (95.0%), by the 7th day 753 (98.7%) and by the 15th day 763 (100.0%).

Still birth was defined as delivery after 28 weeks of completed gestation but the product showed no breathing, cry or muscular move-ments at birth. The proportion of still births in the observed deliveries (live plus still births) was 14/584 (24/1000) as against 5/198 (25/1000) in the deliveries (live plus still births) in which VHWs were not present at birth ($p = 0.55$).

Out of the 763 neonates studied, 40 died during neonatal period; of the 723 surviving neonates, 670 (92.7%) were observed till the 28th day, and 53 (7.3%) were lost to follow up for the following reasons; Mother left the village before 28th day– 25(3.5%); VHW failed to visit baby till 28th day– 16(2.2%); parents refused the observation– 1(0.1%); and reasons not specified– 11(1.5%). We included the available data on these incomp-letely followed up babies in the analysis.

Three sick neonates were hospitalized by the families. None of these died. They too have been included in the analysis.

Maternal Characteristics: Of the 753 mothers of the 763 neonates studied (including 10 twins), 91.2% mothers were in 19-30 years age group and 91.5% with parity £3. As many as 61% were illiterate and 99% were doing agricultural work. Past history of still birth and neonatal death was given by 6.1% and 12.2% mothers respectively. Mean height was 149.6 cm. Only 10.1% were seen by a doctor and 0.1% were hospitalized during current pregnancy. But 79% had received tetanus toxoid–usually given by the govern-ment nurses, and 65.1% had received iron, calcium tablets during pregnancy, most often from the TBAs of SEARCH. Ninety five per cent delivered at home, and 81% were attended by TBA only.

Neonatal Deaths: 40 neonatal deaths occurred in the 763 study neonates, giving the NMR of 52.4 per 1000 live births (95% CI 36.6 to 68.2). Of this, early NMR (1-7 days) was 30.1 per 1000 live births (23/763), and late NMR (8-28 days) was 22.3 per 1000 live births (17/763).

Health Problems in Neonates: Distribution of neonates by maturity and birth weight, and the associated fatality are presented in *Table 1.* Nearly 42% neonates were low birth weight (<2500 g) and 36 out of total 40 deaths occurred in them, out of which 27 deaths occurred in 74 neonates with birth weight <2000 g. Only one death occurred in neonates with birth weight ³ 2500g. Similarly, total 25 deaths occurred in 75 pereterm (<37 weeks) neonates.

Incidence of various high risk health problems, associated case fatality, and relative risk of death are presented in *Table II*. Many neonates had more than one morbidity, and hence they have appeared more than once under different morbidities in the column 'number of sick neonates' in this table. As many as 368/763 (48.2%) neonates suffered from one or more high risk morbidities (mean, 0.92 problem/neonate).

Breastfeeding problems found in 124 neonates (*Table II*) were associated with other problems in following proportion (case fatality in parenthesis): 25.8% with pre-maturity (53.1%), 56.5% with sepsis (32.9%) 5.6% with severe asphyxia (42.9%), 46.0% with maternal health problems including breast problems (31.6%), and 12.1% with no other problem (0%). Most feeding problems were either short lived, or fatal (CF 22.6%). They persisted till 28th day only in 16/723 (2.2%) of the surviving babies.

A total of 551 out of 763 (72.2%) suffered low risk morbidities, (Mean 1.3 problem/neonate). The incidence of various low risk morbidities is presented in *Table III*.

The weight gained by neonates during 0-28 days is presented in *Table IV*. The mean weight gain was 581.7 g/neonate. The effect of weight gain in neonatal period on the subsequent mortality in the second month of infancy is shown in the *Fig.1*. The mortality increases up to weight gain of 300 g, after which it plateaus. Hence <300 g was selected as inadequate weight gain, with 17.9% neonates in this category. The total health problems per neonate were 2.2.

Care Need and the Care Received: Among the 763 observed neonates, 54.4% had indica-tions for health care (presence of a high risk health problem or inadequate weight gain or both). Of the 40 neonatal deaths, 38 occurred in these. But only 2.6% neonates were seen and treated by a doctor, most often private; and only 3 (0.4%) were hopitalized for sickness.

Traditional Beliefs and Practices: Women underfed themselves during pregnancy and strove for a small baby to ensure easy delivery. Babies were not to be breast fed on first three days and baby-clothes were not used till a ceremony (*baj kadhane*) on 5th to 7th day. Mothers could not leave the delivery room till *baj kadhane*. To minimize the toilet needs, they severely restricted their intake of fluids and food during first week after delivery. Mothers did not wash hands properly; their clothes and linen were often dirty. Newborn babies, even if sick, were not moved out of home. The usual explanations for the sicknesses in neonates were 'evil eye', 'witch craft', or ill effects of foods eaten by mother. Neonatal death was stoically accepted.

Discussion

This study revealed a huge burden of neonatal ill health. Forty eight per cent neonates, almost ten times the neonatal death rate, suffered from high-risk health problems. As many as 17% neonates developed clinical features suggestive of sepsis. Though 54.4% neonates had indications for medical care, very few received it. There was a large unmet need for health care.

Was the study population unususal? Poverty and illiteracy in the Gadchiroli district are expected to adversely influence the neonatal health, but the study area was not very deprived of primary health care (11). The socio-economic characteristics of the 753 mothers (results) broadly resemble those of an average rural population in India. Mean maternal height (149.6 cm) was similar to 150 cm estimated mean for India(15). The IMR of 73 in the study villages or NMR of 52.4 in the neonates studied were similar to the national rates for rural areas (IMR 82 and NMR 52.3 in 1993)(16).

Table III - *Incidence of Low Risk Health Problems and Associated Fatality in Home Cared Neonates (n=763)*

Low-risk® Health problems	Sick neonates (0-28 days)		Deaths ⊕	
	No.	Incidence(%)	No.	Case fatality (%)
Birth weight 2000-2499 g	246	32.2	9	3.7
Birth asphyxia - mildψ	81/570 ψ	14.2	3	3.7
Upper respiratory infection	153	20.1	1	0.7
Diarrhea	42	5.5	0	0.0
Unexplained fever	87	11.4	2	2.3
Umbilical sepsis	151	19.8	4	2.6
Skin infection				
Intertrigo	49	6.4	0	0.0
Pyoderma	46	6.0	2	4.3
Conjunctivitis	94	12.3	1	1.1
Physiological jaundice	17	2.2	1	5.9
Neonates with any one of the low-risk health problems (95 % CI)	**551**	**72.2**	**19**	**3.4**
	(69.0 - 75.4)		**(1.9 - 5.0)**	

® Low risk = case fatality <10%.

♠ Diagnostic criteria = see Appendix 1.

⊕ Most deaths occurred in neonates with multiple prolems. The case fatality seen in association with low-risk problems was most often due to associated high-risk problems in the same neonate. Only two deaths occurred in neonates without high-risk health problem.

ψ Actual observations at birth were made by VHWs on 570 neonates.

Table IV - *Weight Gain During Neonatal Period (n=654♣)*

Weight gain (g)	Neonates No.	Incidence (%)	Cumulative incidence (%)
<=0	35	5.4	5.4
1- 99	6	0.9	6.3
100-199	31	4.7	11.0
200-299	45	6.9	17.9
300-399	50	7.6	25.5
400-499	45	6.9	32.4
500-599	111	17.0	49.4
600-699	101	15.4	64.8
700-999	150	22.9	87.8
>=1000	80	12.2	100.0

Mean weight gain: 581.7, SE 13.4

♣ Out of the 723 neonates alive on 28th day, the birth weight was recorded in 654 neonates.

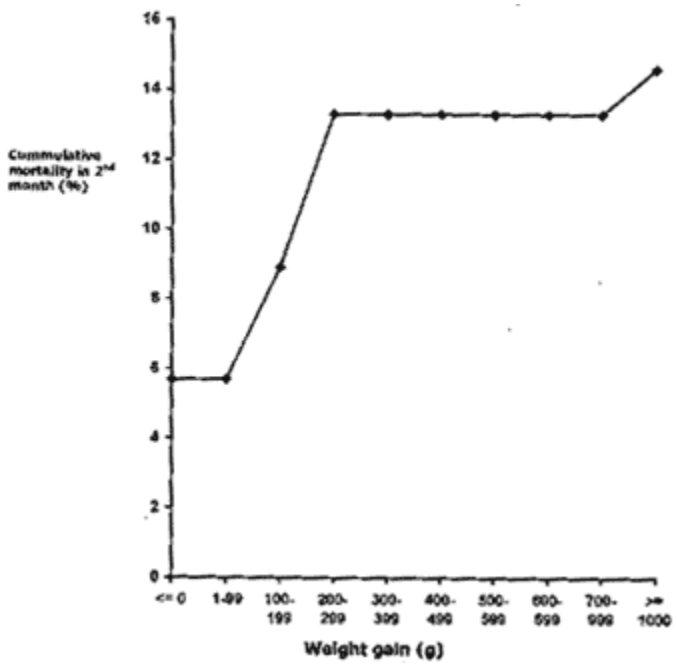

Fig. 1. Weight gain in the neonatal period and the subsequent mortality in the second month of infancy.

Only 75% neonates in the 39 study villages could be studied. Did this introduce a selection bias ? The NMR in the 763 neonates studied (52.4) and in the 253 not studied (47.4) or the still birth rate in the deliveries observed and not observed (24/1000 *vs*. 25/1000) were not significantly different. Thus there was no apparent selection bias. During this one year, 95% women delivered at home; this proportion is more than the reported 83% for rural India(3). Families preferred home delivery because of convenience and tradition.

Direct observation in the natural condi-tions of rural homes became possible because of the VHWs. The quality of training of VHWs and data collection were assessed by an external group of senior pediatricians to be highly satisfactory. The observations recorded by VHWs showed mean 92% agreement with the parallel observations made by physician, thus validating the quality of the data. However, since the VHWs visited neonates only on 8 out of 28 days, we might have missed some transient health problems.

Diagnoses of health problems were based on clinical criteria (*Appendix 1*) for the obvious reasons of feasibility. Hence diagnoses such as sepsis or penumonia in this study should be considered presumptive. However, use of objective criteria will permit a comparison with the observations from other places. Moreover, high case fatality associated with various major health problems (*Table II*) suggested that the diagnostic criteria were reasonably robust.

Incidence of severe birth asphyxia (4.6%) observed in this study was not much different than 3% estimated for the developing countries(17). A high incidence (14.2%) of mild asphyxia observed in this study was based on the direct observation at the time of delivery which was not done in any other community-based estimation; hence mild asphyxia could have been missed in other studies. Retrospective inquiries have reported that 25.9% newborns in rural areas did not cry or cried weakly at birth; and 7.56% were either blue or pale at birth(9), supporting the higher estimate of birth asphyxia in our study.

A 42% incidence of low birth weight (LBW) in this study is higher than the estimated national incidence of 30%(15). This could be explained by combination of poverty, reduced food intake during pregnancy due to cultural beliefs, heavy physical work, maternal anemia (80%) and heavy load of reproductive tract

infections in women in Gadchiroli(18). Besides the associated high neonatal mortality (*Tables I & II*), LBW is also a major risk factor for coronary heart disease during adult life(19), an epidemic which has already been observed in India(20).

We observed a high incidence of sepsis (17.0%) in comparison to 0.3 to 6/1000 live births reported from developed countries(21) or 39/1000 from India(6). However, all other estimates were hospital-based. Since our diagnosis of sepsis was clinical, it should be considered presumptive; however, this study provides the only estimate of the proportion of newborn in community who would be identified as suspected sepsis for manage-ment. Moreover, 18.5% case fatality in these 130 cases of presumptive sepsis, though 55 of them received co-trimoxazole because they also fulfilled the WHO criteria of pneumonia, suggested a serious underlying disease. The steep reduction in case fatality to 2.8% when the neonates with suspected sepsis were treated with gentamicin and co-trimoxazole during later years (1996-98) in this trial(11) supports the presumptive diagnosis of sepsis. Poor hygiene, high prevalence of maternal infec-tions(18), high prevalence of LBW, not feeding colostrum and lack of medical care to neonates could be the possible explanations for the observed high incidence of sepsis.

Since our case definition of sepsis incorporated a period of well being after birth, much of the sepsis in this study must have been acquired after birth. This provides an opportunity for reducing the acquired infec-tion by improving hygiene and breast feeding, and for reducing fatality by early case management of suspected sepsis(11).

Breastfeeding problems were documented in 16.3% neonates and were associated with high case fatality (22.6%). A large proportion of these problems were in association with other high risk neonatal problems such as prematurity, sepsis or asphyxia or with maternal health or breast problems. Most of these can be either prevented or managed. Breastfeeding problem persisted upto 28th day only in 2.2% of the surviving neonates.

Though mean weight gain was 581.7 g, as many as 17.9% neonates showed weight gain less than 300 g during 0-28 days. As the *Fig.1* shows, this adversely affected their subsequent survival, and hence they too needed health care.

Low-risk health problems were observed in 72.2% neonates (*Table III*). A high incidence of upper respiratory infection (20.1%), umbilical stump infection (19.8%), skin infections (6.4% and 6.0%), and conjunctivitis (12.3%) pointed towards poor hygiene, crowding and the large scope for improvement. High incidence of neonatal conjunctivitis due to Chlamydia (8%) and gonococci (3 to 4%) has been reported from Nairobi(22). A high prevalence of reproduc-tive tract infections in rural women in Gadchiroli(18) could explain the high incidence of neonatal conjunctivitis. It was treated by TBAs with 1% tetracycline ointment; none led to conrneal involvement or blindness.

Convulsive disorders were not observed probably because: (*a*) no case of neonatal tetanus occurred because of good maternal coverage with tetanus toxoid and clean practices of TBAs trained by SEARCH: (*b*) our case definition of convulsive disorders excluded sepsis and asphyxia (*Appendix 1*) and; (*c*) the VHWs might have missed transient convulsions.

We have considered presence of a high-risk health problem or failure to gain adequate weight as indications for health care. Though 54.4% of home-cared neonates had such indications and most (38/40) neonatal deaths occurred in babies with such indications, only 2.6% of neonates were seen by a doctor, most often an unqualified village doctor, and only 0.4% were hospitalized. No neonate was seen at Primary Health Centers (two in the study area) and negligible (0.8%) by the govern-ment nurses (16 in the study villages). Parents were either unwilling or unable to hospitalize the sick neonates, and the current Primary Health Care practically did not provide neonatal care.

If parents really hospitalized the neonates with indications, the health care system will be unable to manage such large magnitude of case load. Out of 26 millions neonates born every year in India, 54%, *i.e.*, nearly 14 million neonates will need health care. The cost of hospitalization for observation or

treatment of neonates with indications was reported to be Rs. 714 ($ 15) per neonate in 1992(23). Assuming a 50% increase in cost in last 9 years, India will require nearly 15,000 million Rupees ($ 319 million) each year for providing hospital-based health care to sick neonates. Obviously alternative approaches need to be developed.

Home-cared neonates elsewhere need to be studied before the findings of this study could be generalized.

In conclusion, nearly half of the neonates in rural homes need health care but only a negligible proportion receive it. This suggests an urgent need for developing home-based neonatal care to reduce neonatal morbidities and mortality.

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Contributors: ATB designed the study and the training of workers, directed the fielg work, interpreted the data and wrote the draft of the paper. He will act as the guarantor of the manuscript. RAB trained the workers and interpreted the data. SBB trained the workers and supervised the data collection. MDD performed data analysis. MHR was responsible for data analysis and writing.

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Competing interests: None declared.

Appendix I - Diagnostic Criteria of the Neonatal Health Problems

1. Birth asphyxia

(*i*) Mild: At 1 minute after birth, no cry, or the breath was absent or slow, weak or gasping.

(*ii*) Severe: At 5 minutes after birth, the breath was absent or slow, weak or gasping.

(*iii*) Indirect: In the absence of direct observations by VHWs about newborn's condition at 1 and 5 minutes, presence of following two: (*a*) baby did not cry on its own so the care provider had to make efforts to make the baby cry; and (*b*) color of the umbilical cord was green or yellow.

2. Preterm: Less than 8 months and 14 days (37 weeks) of gestation counted from the onset of the last menstrual period as per the history given by the mother.

3. Low birth weight: Weight less than 2500 g.

4. Delayed breastfeeding: Due to traditional practice, breastfeeding not started in first 24 hours after birth, but baby licked/sucked the sweetened water.

5. Problems in breastfeeding: Presence of any one of the following:

(*i*) Baby did not suck breast for more than continuous 8 hours even when offered.

(*ii*) –Mother unable to breast feed, or

–baby fed on extracted breast milk, or goat, or cow milk, or bottle, or sweetened water beyond 3 days, or

–inadequate breast milk evidenced by continuous crying of baby and failure to gain weight.

6. Diarrhea: Watery, liquid motions 3 or more, or > 9 motions of normal consistency in 24 hours; or mucus or blood in liquid stool.

7. Neonatal Sepsis: (Septicemia, meningitis or pneumonia diagnosed clinically): Simultaneous presence of any two of the following six criteria any time during 0-28 days:

(*i*) Baby which cried well at birth, it's cry became weak or abnormal, or stopped crying; or baby who earlier sucked or licked well, stopped sucking or mother feels that sucking became weak or reduced: or baby who was earlier conscious and alert, became drawsy or unconscious.

(*ii*) Skin temperature >99ºF or <95ºF

(*iii*) Sepsis in skin or umbilicus

(*iv*) Diarrhea or persistent vomiting or distension of abdomen

(*v*) Grunt or severe chest indrawing.

(*vi*) Respiratory rate (RR) 60 or more per minute even on counting twice.

8. Hemorrhage - bleeding from mouth, anus, eyes, nose or in skin or in urine any time or vaginal bleeding after first week.

9. Conjunctivitis - Mother complained of excessive discharge from the eyes of baby and on examination, eyes were red, and purulent discharge or dried pus:

10. Skin Infection:

(*i*) *Pyoderma:* pus, ulcer, boil, pustule in skin.

(*ii*) *Intertrigo:* excoriation with moist, cracked skin at skin folds.

11. Abnormal Jaundice - Skin or eyes yellow on the first day or yellowness persisted at 3 weeks, or when yellowness associated with sepsis.

12. Meconium Aspiration: History of difficult delivery or presence of birth asphyxia and respiratory distress (RR 60 or more; or severe indrawing of lower chest) started in first 24 hours after birth.

13. Hyaline Membrane Disease - Respiratory distress started within 6 hours after birth in preterms baby.

14. Pneumonia - RR 60 or more, persistent even when counted twice (Increased RR when associated with other signs symptoms of sepsis was included in neonatal sepsis).

15. Upper Respiratory Infection (URI) - Cough or nasal discharge present for three days or more without respiratory distress or increased RR.

16. Hypothermia - Axillary temperature <95ºF.

17. Umbilical Sepsis - Pus discharge from umbilicus.

18. Tetanus - Baby which earlier sucked well, stopped taking feeds from 4th day or more; and appearance of seizures, spasm and trismus.

19. Convulsive Disorder - Seizures but baby conscious, alert and feeds well between seizures (excludes tetanus, asphyxia, sepsis)

20. Unexplained fever - Axillary temperature >99ºF without any attributable cause.

21. Failure to Gain Weight - Total weight gain during 0-28 days <300 g.

Key Messages

- Nearly half of the neonates in rural communities experience high risk morbidities and almost three fourth experience low risk morbidities.
- One out of every six neonates develops clinical features suggestive of sepsis with associated high case fatality rate.
- LBW, breastfeeding problems and hypothermia are frequently encountered in neonates in rural homes.
- There is a large unmet need for neonatal health care in rural communities, which needs to be accorded high priority.

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