

A retrospective observational study of obstetric care in rural Andhra Pradesh by Dangoria Charitable Trust (1979 to 2009)

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Background & objectives: In India several models of health care delivery have been explored to increase access to skilled obstetric care in rural areas, where there is a lack of specialists and appropriate facilities. We present here an innovative and affordable approach to the delivery of antenatal and obstetric care provided by the Dangoria Charitable Trust (DCT) since 1979, twinning a not-for-profit hospital in rural Andhra Pradesh with a for-profit one in the capital Hyderabad.

Methods: A retrospective observational study of a random sample of the deliveries performed from 1979 to 2009 by the Dangoria Charitable Trust, based on the maternity hospital birth register, was conducted. The profile of mothers, such as their age, parity and previous miscarriages, as well as type of delivery, gender and birth weight of the newborn, and frequency of stillbirths and in hospital deaths as they evolved over time were presented using simple descriptive methods. The risk of stillbirth and in hospital death over time was explored by logistic regression after allowance for selected factors.

Results: From 1979 to 2009 the cumulative number of deliveries at the Narsapur maternity hospital was 9333, from a few dozens per year in the early 1980s to over 1000 in 2009. The number of primiparae significantly increased over time, while the percentage of low birth weight babies (less than 2.5 kg) did not change appreciably. Caesarean section increased significantly over time, from 8.6 per cent in the first decade to 20.3 per cent in the last. The risk of death (stillbirths and in hospital death) consistently decreased over time, reaching 15 per thousand in the last decade. The results of a logistic regression adjusted for potential confounders showed that low birth weight babies had 4 times the risk of dying as compared to those weighing 2.5 kg or above.

Conclusions: Over the 30 year period the percentage of babies discharged alive from DCT improved considerably. Caesarean sections increased significantly from the first decade to the third decade. The model adopted by the DCT to improve maternal and child health in rural areas could be replicated in other rural parts of the country.

Key words Antenatal care - birth register - in-hospital death - observational study - obstetric care - rural India

India has made significant progress in many indicators of maternal and child health. Infant mortality rate has decreased from about 129 per 1,000 in 1971 to 58 per 1,000 in 2011¹. However, the pace of the decrease has been considered too slow, and considerable differences still remain between urban and rural areas, where 70 per cent of the Indian population lives². Worse pregnancy outcomes in rural India are due to the absence of a well functioning health system, lack of resources and skilled personnel, and low quality of existing interventions, including intrapartum and neonatal care³. The Dangoria Charitable Trust (DCT), a non-governmental organization operating since 1979 in Narsapur village, about 55 km outside Hyderabad (Andhra Pradesh), India, has provided quality health care (skilled gynaecological and obstetric care) to rural women, through an affordable and effective scheme of service delivery through an affordable and effective scheme of service delivery, twinning a not-for-profit and a for-profit institution. In 2009, the Trust completed its 30th year of operation. This paper presents its approach to the delivery of antenatal care. Some essential descriptive data from the birth register are also presented, in the form of a retrospective observational study based on the birth register kept systematically since the opening of the hospital.

Material & Methods

Village Narsapur is located in the Narsapur mandal of Medak district in Andhra Pradesh, India. The large majority of the population is Hindu: about 25 per cent belong to scheduled caste, and 4 per cent are Lambada tribals. The socio-economic characteristics of the district have not appreciably changed over the years, 80 per cent of the families being below the poverty line. Specific data on maternal and child health in the Narsapur mandal are not available, but data from the District Level Household Survey (DLHS-1) from rural Andhra Pradesh may serve as an approximation. DLHS-1 showed in the second half of the nineties that 63 per cent of women living in rural settings received full antenatal care [at least 3 visits, 1 tetanus toxoid injection and iron folic acid (IFA) prophylaxis], and 42 per cent delivered in an institutional setting⁴. In the Narsapur area, in the late seventies, there were a government hospital and two small private nursing homes with limited capability for handling at-risk deliveries. Still today, the government hospital in Narsapur cannot regularly offer caesarean sections for the frequent lack of the anaesthetist or of the obstetrician. Transfer of complicated deliveries to the nearest city,

Hyderabad, is unaffordable for the majority of families. Two private-for-profit nursing homes, offering the full range of obstetric services, opened in Narsapur village in 2002 and 2007, respectively, but most rural families cannot afford to deliver there.

In 1979, the Dangoria Charitable Trust (DCT) Hospital for Women and Children was started in Narsapur. Antenatal clinics were started at the same time the hospital was opened, and were held consistently throughout 30 years (1979-2009), seeing about 2000 women in 2008. In the mid-1990s the Trust started programmes to improve nutrition of the local rural population, and to increase women's uptake of antenatal care, with funding from the Department of Science and Technology, Government of India^{5,6}.

Birth register data: Since 1979, all births taking place at the DCT maternity hospital have been consistently recorded in the birth register, filled in by the gynaecologist or senior midwife using the same data coding strategy. The following data were taken from the birth register: (i) date of delivery; (ii) age of the mother; (iii) parity; (iv) number of previous miscarriages, if any; (v) type of delivery (spontaneous, spontaneous with episiotomy, spontaneous with forceps, caesarean section); (vi) newborn gender; (vii) birth weight; and (viii) outcome (vigorous, non-vigorous, stillbirth, early neonatal death). The outcome category "non-vigorous" indicated newborns that had to be revived but did well thereafter. In part of the analysis the outcomes were grouped into two categories, "discharged alive" (vigorous and non-vigorous babies), versus "deaths" (stillbirths and neonatal deaths). An experienced gynaecologist coded the type of delivery and neonatal outcome, and performed the data extraction.

Statistical analysis: The true observed yearly rate of babies discharged alive was obtained on the basis of the total number of stillbirths and neonatal deaths and the total number of deliveries. However, it would not have been possible to extract data for all 9333 deliveries of the birth register and it was, therefore, necessary to draw a big enough sample for every year to describe the possibly evolving profile of women and babies over time. For sample size considerations the following calculation was used: whatever the characteristics of interest and for the worst case scenario of a true population frequency of the trait of 50 per cent, which corresponds to the largest binomial variability, a minimum of 96 women were necessary in order to obtain 95% confidence intervals of size ± 10 per cent. If the number of women giving births in a given year was

less than 100, all cases for that year were considered. Otherwise, we randomly selected 100 births using a computer-generated list of random numbers. The total sample size over the 30-year period thus amounted to 2374 singleton births. For descriptive purposes only, the estimates of the percentages over each of the three decades of operation (1979-1989, 1990-1999 and 2000-2009) were compared with a test for trend⁷. Using the sample data set and for purely explorative purposes, the percentage of babies discharged alive was further analysed using fixed effects logistic regression⁸ to allow for the effect of the available potential factors affecting early neonatal mortality. All sampled patients with complete data (N=2205) were included in the logistic regression. As a measure of significance of the model the likelihood-ratio chi-squared statistical test and its *P* value were noted. All statistical analyses were performed with STATA software⁹. It should be noted that all women admitted for delivery to the DCT hospital, whether transferred to another hospital for emergency or cared for in-house have always been registered in the birth registry and considered in this report (no exclusions have been applied).

Results

Overall, from 1979 to 2009, the cumulative number of deliveries was 9333. The number of deliveries per year slowly went up from a few dozens in the early 1980s, to hundreds throughout the 1990s. Since 1998 a sharp increase was recorded, growing to more than one thousand since 2007 (Fig. 1). Table I shows the main characteristics of the random sample of 2374 deliveries.

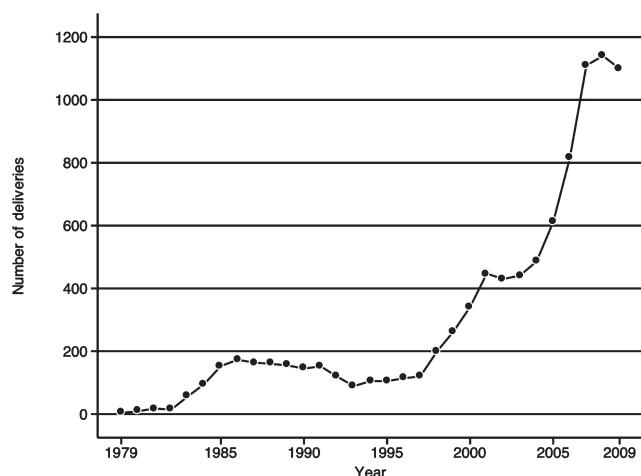


Fig.1. Total number of deliveries by year, Dangoria Charitable Trust Maternity Hospital, 1979-2009.

Table I. Main characteristics of a sample of 2374 deliveries occurring at the Dangoria Charitable Trust Maternity Hospital, 1979-2009

	N	%
Year of delivery		
1979-1989	627	26.4
1990-1999	867	36.5
2000-2009	880	37.1
Age of mother, years		
≤20	876	37.6
21-25	966	41.5
26-30	414	17.8
>30	72	3.1
Previous miscarriages		
No	2247	94.9
Yes	121	5.1
Parity		
0	894	37.8
1-2	1171	49.5
≥3	303	12.8
Mode of delivery		
Spontaneous	1170	49.3
Spontaneous with episiotomy	619	26.1
Forceps	257	10.8
Caesarean section	328	13.8
Gender of newborn		
Female	1177	49.6
Male	1197	50.4
Birth weight, kg		
<2.5	541	23.4
≥2.5	1774	76.6
Baby survival status at discharge*		
Alive	9157	98.1
Dead**	176	1.9

Totals do not add to 2374 if there are missing values;

*Computed on all 9333 registered deliveries.

** Of whom 126 stillbirths and 50 neonatal deaths.

Over the thirty-year period, the age of women at delivery did not appreciably change (Table II). The mean age of women, whether primiparae (parity=0) or otherwise remained fairly stable, the statistical significance probably attributable only to the relatively large sample sizes in each period. Babies weight did not increase in an appreciable way. Analyses (not

tabulated) indicated that primiparae went from 36.6 per cent before 1989 to 48.2 per cent after 2000 (test for trend $P<0.001$). More specifically, women at their first or second pregnancy were 61 per cent before 1989 and 84 per cent after 2000, respectively (test for trend $P<0.001$). The percentage of low birth weight babies (<2.5 kg) was consistently higher in primiparae for all the three time-periods (Table III). Caesarean section increased significantly over time (test for trend $P<0.001$) from 8.6 per cent in the first period to 20.3 in the last period (Table IV).

Delivery outcome, in terms of the in-hospital mortality rate of the baby (stillbirth and neonatal death), was computed for every year on the basis of the full data set (9333 deliveries) counting the total number of events and the total number of deliveries. The percentage of babies discharged alive improved considerably over time (Fig. 2). In particular, in the last decade, stillbirths amounted to 11 per thousand and neonatal death to 4 per thousand. In 2009 (1099 births, 15 stillbirths, 0 neonatal deaths, data not tabulated) the overall in-hospital mortality rate was 14 per thousand. Table V presents the results of an exploratory logistic regression on the risk of in-hospital death according to time period, performed on the 2276 complete records from the sampled data set, after allowance for the effect of the available potential confounding factors. The risk

decreased significantly after the first decade, down to 28 per cent (95% CI 14 to 55%) and to 40 per cent (95% CI 21 to 76%) of the risk for the initial period in the decades 1990-1999 and 2000-2009, respectively. Low birth weight children had more than 4 times the risk of dying as compared to children with weight of kg 2.5 or above ($P<0.001$). None of the other factors considered in the regression achieved statistical significance but the overall likelihood-ratio chi-squared test value was 42.7 with 8 degrees of freedom ($P<0.001$).

Discussion

In India rural women have rarely access to institutional deliveries mainly because of lack of skilled personnel in government facilities, and in particular obstetricians^{10,11}. It is estimated that in rural areas of Andhra Pradesh less than half of the number of obstetricians required to guarantee coverage is actually available¹². The simultaneous presence of an obstetrician and an anaesthetist in rural area hospitals is infrequent¹³. In addition, rural hospitals may rarely rely upon a close by network of integrated perinatal facilities for emergency services as in rural areas of developed countries^{14,15}.

Many options have been proposed for developing countries to improve maternal and child health^{16,17}. In Tamil Nadu, contracting local specialists and

Table II. Age of mothers by parity and decade, DCT maternity hospital, 1979-2009

	Parity = 0 $P=0.034$			Parity ≥ 1 $P<0.001$		
	N	mean age	95% CI	N	mean age	95% CI
Year of delivery						
1979-1989	222 (4)	19.8	19.4-20.2	373 (24)	25.2	24.8-25.6
1990-1999	242	20.4	20.0-20.7	619 (5)	25.3	25.0-25.6
2000-2009	423 (3)	20.3	20.0-20.5	451 (2)	23.6	23.3-23.8
Values in parentheses show missing data						

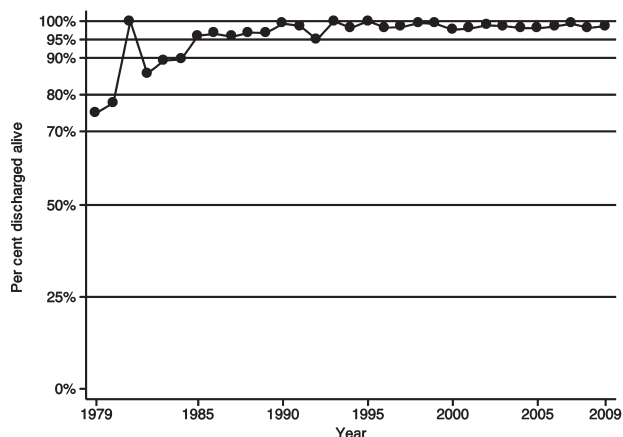
Table III. Percentage of low birth weight (LBW) by parity and decade, DCT maternity hospital, 1979-2009

	Parity = 0 Test for trend, $P=0.360$			Parity ≥ 1 Test for trend, $P=0.75$		
	N	% LBW	95% CI	N	% LBW	95% CI
Year of delivery						
1979-1989	61/218	28.0	22.1-34.4	71/376	18.9	15.1-23.2
1990-1999	98/242	40.5	34.2-46.9	119/617	19.3	16.3-22.7
2000-2009	112/416	26.9	22.7-31.4	80/442	18.1	14.6-22.0

Table IV. Caesarean section by decade, DCT maternity hospital, 1979-2009

	N	%	95% CI
Year of delivery (Test for trend $p < 0.001$)			
1979-1989	54/627	8.6	6.5-11.1
1990-1999	95/867	10.9	8.9-13.2
2000-2009	179/880	20.3	17.7-23.2

outsourcing the ambulance service to a local non-governmental organisation¹⁸ have addressed the lack of medical specialists in rural areas. In Gujarat, in order to increase institutional deliveries, the government established a pilot mechanism of public payment to private doctors and midwives practicing in private nursing homes¹². Insurance schemes to spread the per capita cost through the community have also been advocated but judged difficult to implement¹³. In all such approaches, a trade-off had to be found to make available high standards of care at an affordable price while offering suitable incentives to skilled professionals who would otherwise be more easily attracted to urban areas. The innovative delivery of care approach developed by DCT, a collaboration between a not-for profit and a for-profit institution, has provided full obstetric services, at an affordable cost. The preliminary examination of the antenatal records (a random sample of 5%) of the deliveries having occurred in 2010 showed that women had on average eight antenatal visits, a satisfactory number of contacts with medical personnel corresponding to a total of ₹ 260. A normal delivery costed ₹ 1000, and a caesarean section ₹ 5000 in 2010. The cost of antenatal care and

**Fig. 2.** Per cent of children discharged alive by year, Dangoria Charitable Trust Maternity Hospital, 1979-2009.**Table V.** Logistic regression on 2276 women with complete data

	OR	95% CI	P value
Year of delivery			
1979-1989	1	reference	-
1990-1999	0.28	0.14 - 0.55	<0.001
2000-2009	0.40	0.21 - 0.76	0.005
Age of mother, years			
≤20	0.56	0.28 - 1.11	0.098
>20	1	reference	-
Previous miscarriages			
No	1	reference	-
Yes	1.11	0.38 - 3.23	0.874
Parity			
0	1.3	0.67 - 2.53	0.430
≥1	1	reference	-
Mode of delivery			
Caesarean	0.85	0.37 - 1.95	0.700
Other	1	reference	-
Gender of newborn			
Male	0.86	0.51 - 1.48	0.591
Female	1	reference	-
Birth weight, kg			
<2.5	4.19	2.43 - 7.24	<0.001
≥2.5	1	reference	-
OR, odds ratio			

delivery thus compare favourably to the costs reported by other studies^{13,19,20}.

The analysis of the Registry data showed that the profile of women did not change over time as concerns age at delivery, but parity significantly decreased. The data suggested little if any change in birth weight over time, in line with most evidence from India suggesting limited effect of policies to reduce malnutrition^{21,22}.

Three aspects, generally considered informative indicators of quality of obstetrics care, are of particular relevance: (i) the ever-increasing number of deliveries; (ii) the achievement of very low perinatal death rates; and (iii) the satisfactory rates of caesareans sections. According to the District Level Household Survey (DLHS), the percentage of institutional deliveries in the district has considerably increased in the last decade, from 51 per cent (DLHS-1, 1998-1999, data on rural Andhra Pradesh) to 72 per cent (DLHS-3,

2007-2008, specific data for Medak district)^{3,23}. The rise in attendance of the DCT maternity hospital (increasing five-fold in the last 10 years of operation with respect to the previous decade) may be attributed to the fact that when skilled and affordable medical care is provided in a safe environment, rural women do not hesitate to use it. As a proxy for perinatal mortality, our records show a rate of death (stillbirths plus neonatal deaths) in the last decade of 15 per thousand, which is probably an underestimate of the true rate but fares very well against the perinatal mortality rate of 31.6 per thousand for rural India²⁴. Although the appropriate rate of caesarean section is controversial, the rate of 5.6 per cent reported for rural India¹ and the rate of 10.9 per cent of Tamil Nadu²⁴ are both considered low. Studies from across the world have documented an increasing global trend in caesarean section rate that may be influenced by the composite effect of several factors not individually quantifiable: ability to pay, fear of legal consequences, convenience, perceived safety, and fear of inadequate care. It is likely that these factors have affected the rise observed in our study²⁵.

The study had many limitations. First, other factors, not recorded in the Hospital Birth Registry, could have influenced the pregnancy outcomes over three decades, such as change in risk status of the mothers and change in techniques for newborn management. The retrospective nature of the study, as well as the limited information available from the birth registry, did not allow to identify causal factors, but only to describe associations. However, the strength of the dataset was that information was consistently collected over 30 years, allowing for a description of pregnancy outcome in a rural maternity hospital.

Preliminary data from a survey of 221 women attending the antenatal clinic at DCT in 2011 show satisfaction with care and demonstrated that the DCT was highly regarded in the area: 58 per cent of women found the cost of care was difficult to afford, nonetheless 87 per cent of women thought that DCT provides high quality care for a reasonable price and 98 per cent of women would recommend DCT to relatives and friends.

In conclusion, the DCT maternity hospital provided gynaecological and obstetric care at the doorstep of a rural community, at an affordable price, in order to avoid unnecessary morbidity and mortality of mothers and children in rural Andhra Pradesh. This goal was

achieved through a simple and sustainable approach to delivery of care, which could be replicated in other rural areas.

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