IMPACT OF MATERNAL AND CHILD HEALTH STRATEGY ON CHILD SURVIVAL IN A RURAL COMMUNITY OF PONDICHERRY

Debashis Dutt and D.K. Srinivasa

From the Department of Preventive and Social Medicine and Center for Disaster Preparedness and Training, Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry, 605 006.

Reprint requests: Dr. Debashis Dutt, Assistant Professor, Department of Community Medicine, Kasturba Medical College, Manipal, Karnataka 576 119.

Objective: To determine the impact of Maternal and Child Health (MCH) services on child survival in a socio-economically backward rural community. **Setting**: Twelve villages in Pondicherry **with** a population of16803. **Design**: Prospective study. **Subjects:** A birth cohort of 356 live births (LB) born between January 1st and December 31st 1988. **Methods**: The live births were followed-up from birth to five years age (1988-1993). The health care received by this cohort and the antenatal services received by the cohort mothers ivas reviezued. Outcome measures related to child survival were determined and their changing trend since 1967 was examined. **Results**: Fifty-four per cent of the cohort children were from families below the poverty line. Antenatal registration and tetanus immunization coverage of the mothers of the cohort was 100%. Immunization coverage of the cohort children was more than 98% for BCG, DPT (three doses) and OPV (three doses) and 82% for measles. The infant mortality rate had reduced from 201/1000 LB in 1967 to 64/1000 LB (95% C I 58.9-68.1) in 1989. The child death rate decreased from 29.4/1000 children 1-4 years of age (1970) to 18/1000 (95% C I 13.9-22.1) in 1992. There were no deaths due to neonatal tetanus or measles. Neonatal mortality (35/1000 LB; 95% CI 29.9-40.1) was higher than the post-neonatal mortality (29/1000 LB; 95% C I 24.1-33.9). Fifty eight per cent of the neonatal deaths lucre due to non-infective causes like prematurity, birth asphyxia, birth injuries and congenital anomalies. Eighty per cent of post neonatal deaths were due to infections. Overall, the child survival index was high (91.27%; 95% C I 88.14-94.26). This was inspite of the low socio-economic background of the children's families. **Conclusions**: Good MCH services can substantially improve child survival inspite of prevailing low socio-economic situations. Inputs for neonatal care need to be strengthened to further enhance child survival.

Key words: *Child survival, Infant mortality, Maternal and child health strategy.*

SURVIVAL of infants and children remains one of the most important issues in the developing world. Every year 15 million children below the age of five years die in the developing countries (1). The causes and determinants of infant and child mortality have been well studied and they range from biological to socio-economic variables (2-4). Efforts have been directed to enhance child survival for several decades and though the infant and child mortality rates have been decreasing, they still remain at unacceptably high levels, in the developing countries. Twenty to twenty-five per cent of the children born in developing countries die before their fifth birthday (5). This figure is very high when compared to that in the developed countries where only

about 2% of the children die before the age of five years(5). Improper utilization of health services could be an important factor responsible for the high mortality observed in the developing countries. Periodic evaluation of maternal and child health services are required to determine the utilization of these services and the need for changes in strategy.

Since 1966, the Jawaharlal Institute Rural Health Center (JIRHC) attached to the Department of Preventive Medicine in Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) has been providing comprehensive health care to a population of 16803 living in twelve villages in Pondicherry in South India. Considerable emphasis has been put on provision of Maternal and Child Health (MCH) services through clinic and outreach activities.

In 1967 a health survey was conducted to record the baseline health status of the population of JIRHC service area. Census enumeration was done and data regarding vital events, housing and sanitation were collected by house visits for the entire population. Data on morbidity and socio-cultural factors were collected from a sample of four villages. Among the important MCH indices, the infant mortality rate was 201/1000 live births (LB), maternal mortality was 10/1000 LB. Eighty-three per cent of the deliveries were conducted by untrained traditional birth attendants(6). The present investigation, undertaken two decades after the institution of this health center, was an evaluation of the impact of the MCH services on child survival in this community.

Subjects and Methods

The study was conducted between 1988 to 1993 in the 12 villages in Pondicherry (population 16803, 1988) catered to by JIRHC. Eighty-two per cent of the population in this area depend mainly on agriculture for their livelihood. Seventy per cent live in thatched mud-huts. Sixty-one per cent of the families have annual incomes below the poverty line (Rupees 11750) per family per year (7).

JIRHC is staffed with two medical officers, three public health nurses, two auxiliary nurse midwifes, two pharmacists, one social worker and sanitary inspector each and other ancillary staff. A vehicle with a driver is stationed 24 hours for transport of referred patients during emergency.

MCH care is delivered as a package of services through both clinic and outreach activities. In addition to medical facilities available round the clock, there are weekly antenatal and under-five's clinics. Home visits are made by Public Health Nurses for antenatal and child care. The progress of pregnancy is monitored and simple illnesses are treated. Mothers are educated about child birth, child care, breastfeeding, immunizations, family spacing, and home economics. Iron folate tablets are distributed and the mothers are reminded to bring their children for immunizations on due dates. Community participation through Anganwadis under the Integrated Child Development Services (ICDS) Scheme (8) support MCH activities. High risk mothers and children are identified and when necessary, referred to JIPMER hospital, twelve kilometers away, for tertiary care.

A cohort of 356 live births born between January 1st and December 31st 1988 in the twelve villages were followed up prospectively from birth to five years of age. The health care received by this cohort till five years of age, including antenatal care received by the mothers of these children was reviewed. Outcome measures related to child survival, namely child survival

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index, the infant and child mortality rates and the causes of infant and child mortality were determined. In addition, some of the factors influencing infant deaths, namely, birth weight, birth order, sex of baby, age of mother at childbirth, nature of delivery, place of and person conducting delivery were also studied.

Data were collected by a postgraduate student of Community Medicine using a specially designed and pretested proforma. Information gathered consisted of:

(i) *Maternal characteristics and antenatal care (ANC) received by the mothers of this cohort during pregnancy:* Age, gravidity, parity, time (trimester) of registration for *ANC,* number of clinic and home contacts for ANC, tetanus toxoid immunizations, iron and folic acid supplementation and nutritional supplementation.

(it) *Intranatal events:* Place and type of delivery, personnel conducting delivery and birth weight.

(Hi) *Postnatal events:* Postnatal care received by the cohort which included the number of clinic and domiciliary visits, immunization and nutritional supplementation.

The cause of child deaths during the follow-up period was determined by consulting death certificates and by verbal autopsy, if the death certificates were not available.

Information on maternal characteristics, antenatal care, delivery details were collected by reviewing the antenatal, birth and immunization registers maintained at the health center. This center has an elaborate system of record maintenance. Cross indexing of family folders, antenatal, birth, under-five and immunization registers enable confirmation of identity and system-

atic record linkage(9). Information on postnatal events were collected prospectively by interviewing the mothers of the children supplemented by review of the child health registers and immunization records.

Results

In 1988 there were 356 live births, 171 male and 185 female. Fifty-four per cent of these were from families that had annual incomes below the poverty line (< Rupees 11750 per year). Seventy eight per cent came from agriculture based families. During the period of five years, fifteen families had migrated and were lost to follow-up. The results apply to the remaining 341 live births.

Health Care Received

In the antenatal period all the mothers of the children of this cohort were registered for antenatal care in JIRHC. Thirty seven per cent of the registrations were in the first trimester, 58% registered in the second and the remaining 5% in the third trimester. On interviewing the mothers, it was found that they preferred to time their first pregnancy check up on an odd month of gestation as odd months were considered auspicious. This was the main reason for the fifth month registrations observed in the study.

All the mothers had complete immunization against tetanus and 63% availed nutritional supplementation from the anganwadis. Eighty-eight per cent of the mothers had at least three contacts with the primary health center staff during the antenatal period. Ninety four per cent of the deliveries were conducted by trained personnel.

In the postnatal period more than 98% of the children had received the full course of DPT, OPV and BCG immunizations. Eighty two per cent received measles vacci-

nation. Sixty seven per cent of the children had received at least three home visits per year for under-five care for the first three years. Seventy one per cent of the children had received supplementary nutrition from anganwadis under the ICDS scheme.

Outcome Indices

Three hundred and eleven out of the initial 341 children were alive at the end of five years giving a child survival index of 91.2% (95% CI 88.14-94.26). The infant mortality, neonatal mortality and post neonatal mortality rates were 64/1000 LB (95% CI 58.9-68.1), 35/1000 LB (95% CI 29.9-40.1) and 29/1000 LB (24.1-33.9), respectively. The under-five mortality, 1-5 year mortality and child (1-4 year) mortality rates were 88/1000 lilve births (95% CI 84.5-91.5), 25/1000 children aged 1-5 years (95% CI 20.4-29.6) and 18/1000 children aged 1-4 years (95% CI 13.9-22.1), respectively.

The sex specific death rate for infants was higher among males (85/1000 male LB, 95% CI 81.2-88.8) than among females (45/1000 female LB, 95% CI 39.7-50.3). The reverse was seen in the 1-5 year period where the death rate for males was lower (13/1000 males aged 1-5 years, 95% CI 9.4-16.6) than that for females (35/1000 females aged 1-5 years, 95% CI 29.9-40.1).

Causes of Death

In the neonatal period prematurity was the commonest cause of death accounting for 25% followed by bronchopneumonia (16%). Birth asphyxia, birth injuries and congenital anomalies accounted for 33.2% of the deaths. Infections like acute respiratory infections (ARI) and gastroenteritis caused 24.9% of the deaths. There were no deaths due to neonatal tetanus.

In the post neonatal period infections were the commonest cause of death. ARI, acute diarrheal diseases (ADD) and septi-

cemia were responsible for 50%, 20% and 10% of the deaths, respectively. The remaining 20% of the deaths were due to causes like nephrotic syndrome and congestive cardiac failure. There were no deaths due to measles, a very common cause of infant mortality in India.

In the 1-5 years period, ARI and ADD were responsible for 75% of the deaths. Two deaths were due to accidents in girls aged four to five years, one of whom had fallen into a well and the other had succumbed to a road-traffic accident. The cause of death for one child could not be identified.

Determinants of Infant Mortality

Though the sex specific death rate for males was higher (85/1000 male LB) than that for females (45/1000 female LB), the difference was not statistically significant. As shown in *Table I,* infant mortality was inversely proportional to birth weight ($p < 0.001$). Infants of birth order one, or more than four had higher mortality rates *(Table II).* Birth order two infants had the least mortality. The differences were however not statistically significant ($p > 0.05$). Infants born of mothers less than 19 years of age or more than 35 years age were found to have significantly higher ($p < 0.05$) mortality rate *(Table III).*

TABLE I- *Relation Between Infant Mortality and Birth Weight*

Birth weight (kg)	Number of births	Number of deaths	Death rate
<2.0	18	8	444.4
2.0 – 2.5	34	6	176.4
2.6 - 3.0	257	7	27.2
Not recorded	32	1	
Total	341	22	64

Per 1000 live births of the same birth weight category. $X^2 = 42.07$; $p < 0.001$

TABLE II- *Relation Between Infant Mortality and Birth Order*

Birth Order	Number of births	Number of deaths	Death rate*
1	109	8	73
2	99	4	40
3	57	3	52
>3	76	79	2
Total	341	22	64

* Per 1000 live births of the same birth order.

TABLE III- *Relation Between Infant Mortality and Age of Mother*

Age of mother (yrs)	Number of births	Number of deaths	Death rate*
<20	112	8	71.4*
20-34	222	12	54.8
>34	7	2	285.7*
Total	341	22	64

*Per 1000 live births of mothers in the same age group. * p < 0.05.

The mortality rate among infants born by normal spontaneous deliveries was 62/1000 LB. The mortality rate for infants delivered by forceps was very high (166/1000 LB) (p <0.01 compared with normal deliveries). For operative (Cesarean section) deliveries, the death rate was 66/1000 live births (p < 0.05).

Babies delivered by trained dais had the least mortality rate (8/1000 LB). The mortality rate was highest for babies delivered by untrained dais (210/1000 LB; p < 0.01) followed by that for babies delivered by hospital staff (85/1000 LB; p < 0.05). The high death rate among babies deliveries by hospital staff could be due to the high risk pregnant women going to hospital for delivery.

Discussion

There has been a good utilization of MCH services as evidenced by the registration of all the cohort mothers for antenatal care and their complete immunization coverage for tetanus toxoid (two doses or booster as applicable). However, there is a need for improving early antenatal registrations. Since the time of antenatal registration is determined by traditional customs in this area, repeated Information, Education and Communication (IEC) activities are required to motivate pregnant women to register early. The fact that 37% of the mothers did register in the first trimester indicates a positive trend in this direction.

Deliveries conducted by trained personnel increased from 16% in 1967(6) to 94% in 1988. Immunization coverage of the cohort children for DPT, OPV and BCG (>98%) were well beyond the targets (> 85%) set by the Government of India to be achieved by 2000 AD(10).

Among the outcome measures, infant mortality had decreased from 201/1000 LB in 1967(6) to 64/1000 LB in the present study. The mortality pattern during infancy had changed considerably since 1967 when almost three-fourth's of the infant deaths (71%) were due to infections(6). In the present study, infections contributed to 54% of the infant deaths. A significant observation was that there were no deaths due to neonatal tetanus. This may be attributed to the complete immunization coverage against tetanus among the cohort mothers during their antenatal period and 94% of their deliveries being conducted by trained personnel. There were no deaths due to measles also.

With a decrease in the infant mortality, the proportion of infant deaths in the neonatal period compared to that in the

post-neonatal period had also changed since 1967. Between 1967 and 1971 the post-neonatal mortality had been higher (average 46/1000 LB)(11) than the neonatal mortality (average 41/1000 LB)(11) which is the usual pattern seen in the developing regions. The post-neonatal mortality had steadily decreased from a peak of 60/1000 LB(11) in 1968 to the present level of 29/1000 LB (1989). The neonatal mortality had shown a slower decline from a peak of 39/1000 LB in 1970(11) to the present rate of 35/1000 LB (1989).

The considerable decrease in the post-neonatal mortality, mostly due to infections(6) may be because of the high emphasis for childhood immunizations, under-five care, and supplementary nutrition for under-five children in this area. In the present study, the immunization coverage of the cohort children was high, 71% of the children had received supplementary nutrition till five years of age and 67% of them had received a minimum of three home visits per year by Public Health Nurses for child care for the first three years.

The slower decline in the neonatal mortality is because of the mainly non-infective nature of the conditions causing neonatal deaths which are relatively difficult to control. More than half (58.2%) of the neonatal deaths in the present study were due to non-infective causes. Twenty five per cent of them were due to prematurity and 16% were due to birth asphyxia. In the developing countries, institutional care for these newborns is expensive, often not available or accessible. Simple methods that can be applied in field conditions need to be devised and made popular.

Training of traditional birth attendants and health worker females on neonatal resuscitation and neonatal care has been successfully field tested in Chandigarh, India(12) and needs to be emphasized,

Kangaroo Mother Method (keeping premature or low birth weight infants upright in contact with the mother's breast) is an inexpensive method for preterm care and has proved to be quite effective(13). To further decrease the infant mortality rate, the MCH strategy needs to incorporate such inputs for neonatal care.

The child death rate decreased from 39.4/1000 children 1-4 years of age in 1970(4) to 18/1000 in the present study. The mortality rates for under-fives (88/1000 LB) and for children aged 1-5 (25/1000 children 1-5 years) in this study were much lower than the contemporary rates for India which were 148/1000 live births and 55/1000 children 1-5 years, respectively(15).

In the 1-5 year period more girls died than boys which is opposite to the observation during infancy. Though, in a subsequent study we found no differences in the utilization of under-five's services between boys and girls in this area(16), the question about discrimination against the girl children requires investigation for the observed increased girl child mortality.

Overall, the child survival in this study was high (child survival index 91.2%) which was more than the contemporary child survival index for India (84.2%)(17).

This study documents a substantial decrease in infant mortality in a rural community in India with well established MCH services for twenty years. The mortality rates are much lower as compared to other parts of India. The infant mortality rate is well within reach of the target set by the government for 2000 AD(10).

The difficulty in establishing a causal association to the impact of health care programmes is well known(18). Though we

cannot say with certainty that the observed improvement of child survival in this area was in fact due to the good MCH care provided, there is evidence to indicate that the MCH services did contribute to the better child survival. Though we did not do statistical analysis of the change in the socio-economic status, since 1967 the study population has continued to be agricultural based with 70% staying in the kutcha houses and 61% living below the poverty line indicating a low socio-economic status. The marked improvement since 1967 in antenatal registrations, presence of trained attendants during delivery; the high coverage for immunization, nutrition supplementation and contacts for under five care for the cohort children offer a plausible explanation for the improved child survival observed. Provision of MCH care was facilitated by the adequate staffing of the health center. The importance of good MCH services for improving child survival has been mentioned by others(19,20) and is emphasized by the observations in the present study. The study also highlights the need for strengthening neonatal care to further enhance child survival.

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