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RESEARCH ARTICLE

Factors Associated with Newborn's Survival: A Cross-Sectional Study at two Districts of Bihar

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Abstract

Family Participatory Care (FPC) is a relatively new concept adopted in SNCUs in India. Its effect on survival outcomes of sick newborns has not been studied much. As such newborn mortality studies are rare due to their large sample scale requirement. This is one of the few studies which have been conducted using primary data on this subject in India. In our study, we have found similar causes of death among newborns as published by renowned studies. Study findings highlighted that FPC may reduce newborn mortality by reducing the length of stay at the facility, newborn growth, and survival outcome of sick neonates, especially Kangaroo mother care and exclusive breastfeeding are key components of FPC, and help in reducing newborn deaths. **Objectives**: Family Participatory Care (FPC), a cost-effective innovation implemented in Special Newborn Care Units (SNCUs) where vulnerable newborns are treated, is a well-established concept akin to Family Centered Care (FCC) in developed nations. The study aims to assess the impact of FPC on the survival rates of sick neonates in SNCUs. The study explored the factors associated with the care of sick neonates after discharge from SNCU that adapted FPC and that did not adapt FPC. **Methods:** A multistage random sampling method was used to examine sick neonates and newborns discharged from Special Newborn Care Units (SNCUs) in selected districts of Bihar namely Nalanda SNCU with Family Participatory Care (FPC) and Vaishali SNCU without FPC. **Findings:** The study found a notable variance in the rate of newborn mortality between the district implementing Family Participatory Care and the district that did not implement FPC, with the former experiencing nearly double the rate of newborn deaths. 11 key factors (maternal, household, family support, newborn health-related) attributing towards newborn survival status were identified in this study. **Novelty:** Family Participatory Care (FPC) is a relatively new concept in India, and this is one of the few studies that have been conducted on this subject.

Keywords: Neonatal death; Family Participatory Care; Newborn Survival; Newborn Care; Family participation in Newborn care

1 Introduction

The Neonatal period, i.e. the Initial 28 days of a child's life, is the most susceptible period for a child and vital for his or her survival. Out of approximately 6.6 million under-five deaths, about 44 % occurred in the neonatal period[(1)]. Sub-Saharan Africa region remains the region with the highest under-five mortality rates yet, the segment of neonatal deaths among those deaths is comparatively lower (37 percent) than South Asia (62 percent). Another concern across regions and countries is the vast disparity reflected in the 2019 and 2023 United Nations Inter-agency Group for Child Mortality Estimation (UNIGME) report[(2)], in the level of neonatal mortality. As per the UNIGME report, a child encounters the maximum risk of dying in the first month of life. The likelihood of death reduces after completion of the first month and before completing age 1. The neonatal period is the most significant period for child survival as well as the most challenging time in the life of a newborn[(3)].

Current IMR is 33 in India and NMR is 23 as per Sample Registration System (SRS) 2017[(4)]. Though this is almost one-fourth as compared to IMR in the year 1971 at 129 infant deaths per thousand live births, there is a wide regional disparity in India's NMR in rural areas and its urban areas.NMR in rural areas is 34 as compared to 17 in urban areas. Rural rates are twice the urban rate[(5)]. As per the Sample Registration System (SRS) 2013, this disparity has been unchanged for five years. The neonatal Mortality Rate (NMR) of India then was 28, in rural India it was high at 31, and in urban India, it was 15.

The Bellagio child survival series[(6)], elaborated on the importance of more work in the area of neonatal mortality as well as the improvement of health systems. The study emphasized the need to improve newborn care as well as its cost in the high-mortality setups. For improving newborn survival outcomes, the place where care is provided is important during the critical 28 days, whether it is a facility or home. Ideally, a combined effort of facility-level care, as well as home-based care, can enhance improvement in newborn care. Several studies and guidelines have established the importance of facility-based interventions and timely referral[(7–9)] of the sick neonate by health workers to reduce neonatal mortality by 25-30%[(10)].

Special Newborn Care Units (SNCUs) were implemented as a significant intervention to enhance health systems and support the well-being of sick newborns in the initial of life. SNCUs have been established as specialized care units near labor rooms for sick newborns at district and sub-district hospitals where the delivery capacity is more than 3000 annually. The labor room, as well as the unit, may have 12 or more beds. The human resources at the SNCUs are trained doctors, nurses, and support staff who provide around-the-clock services. SNCUs have been set up to offer various neonatal care practices, excluding assisted ventilation and major surgery. Family participatory care (FPC) is a low-cost innovation approach introduced in SNCUs where newborns are most vulnerable as they are either sick or with low birth weights. It is a well-known concept in developed countries popularly known as Family Centered Care (FCC)[(10–13)]. In India, FPC is developing as an innovative practice of facility-based newborn care, and its effect is yet to be known.

2 Methodology

A community-based multi-stage random sampling was used to study sick neonates. In the first stage, two districts of SNCUs were purposively selected in Bihar, one practicing FPC and one not practicing FPC. In the second stage, a list of all newborns admitted to the SNCU and about to be discharged in a healthy state (excluding LAMA and death) and their details were generated. Mothers of these newborns were interviewed at the facility during or after discharge till the target neonates were completed and later at their homes. 683 newborns for each district were the calculated sample using EPI info. The final sample used for this study was 1458 neonates i.e. (725) Nalanda and (733 neonates) Vaishali accounting for non-responses during the study period of October 2022 to July 2023.

3 Results

Findings at the household level were that most respondents were rural Hindus and belonged to a low socio-economic status. Most respondents belonged to the other backward class.

Mother's demographic characteristics indicated that age at marriage was majorly 18 to 20 years in both districts (approx.70%). Around 61% of the mothers in Vaishali had primary school or below education while more than one-third of mothers in Nalanda had secondary education (36%) and primary (39%) education. While the proportion of higher and above educated mothers in both Nalanda and Vaishali were almost equal (26% and 23% respectively)[(14–16)]. The proportion of underweight mothers was higher in Vaishali (19%) compared to Nalanda (4%).

Nearly 6.2% of parents had confirmed taking loans for newborns in Nalanda while 21.7% in Vaishali district parents confirmed taking loan amount of 11k to 30k. In both districts, most children were up to 2 only. Around 91.8% of the mothers in Vaishali had less than ten years of schooling which indicated the poor status of education as compared to Nalanda (74.6%). In Nalanda, 97.1% of families confirmed having a separate room for newborns while in Vaishali 52.7% of families confirmed

having a separate room for newborns.

In Vaishali (8.38%) proportion of death was found higher in newborns as compared to Nalanda (4.70%). Some of the major characteristics of the population were that most were families of 4 or more Hindus from rural areas and from below the poverty line (94%).[17,18] Most belonged to the other backward class (60% approximately) and scheduled caste and scheduled tribe (30%). Above half of the population lived in semi-kachha homes[18].

Table 1. Household Characteristics of the Newborn

Description of Socio-Demography		
	n	**%**
Religion		
Hindu	1389	95.27
Muslim	69	4.73
Caste		
General	129	8.85
OBC	888	60.91
ST	7	0.48
SC	434	29.77
Card type		
APL(Blue)	85	5.83
Antodaya (yellow)	1	0.07
BPL(RED)	1372	94.10
Type of house		
Kaccha	493	33.81
Pucca	276	18.93
Semi kaccha	689	47.26
Govt Scheme under which House Constructed		
Pradhan Mantri Awas Yojna	476	32.65
No	955	65.50
Don't Know/ Can't Say	27	1.85
Fuel cooking HH (Primary)		
Chulha	618	42.39
LPG Gas	840	57.61
Fuel cooking HH (Secondary)		0.00
Chulha	1040	71.33
LPG Gas	96	6.58
Stove (using kerosene oil)	322	22.09
Main cooking fuel		
Cow dung cakes	156	10.70
Crop residues	244	16.74
Electricity	82	5.62
Kerosene and wood	319	21.88
Wood	657	45.06
Total	**1458**	**100**

Table 2. Demographic Characteristics of Parents of the Newborn

Description	n (%)
Age of husband (in years)	
<=22	394(27.02%)

Continued on next page

Table 2 continued

23 and above	1064(72.98%)
Age of mother (in years)	
Less than 21	896(61.45%)
21_Above	562(38.55%)
Husband education	
<=10 years of schooling	1252(85.87%)
>10 years of schooling	206(14.13%)
Mother's education	
<=10 years of schooling	1214(83.26%)
>10 years of schooling	244(16.74%)
Husband's occupation	
Labour/Daily Labourer/Farmer	1197(82.10%)
Painter/Mason/Driver/Electrician	87(5.97%)
Shop/Private Job/Tutor/Govt. Job	174(11.93%)
Total	1458(100%)

As per Census 2021, in Bihar sex ratio is 1090 females per 1000 males. But we found in the study that most newborns were males (64%) while 36% were females.

Table 3. Comparison of Newborn's Survival Outcome by Selected FPC-Related Factors

Description	Nalanda				Vaishali			
	Alive		Dead		Alive		Dead	
	n	%	n	%	n	%	n	%
FPC Practiced at home								
10% FPC practiced	0	0.00	0	0.00	63	9.36	0	0.00
20% FPC practiced	666	96.66	0	0.00	14	2.08	0	0.00
30%FPC practiced	19	2.76	0	0.00	21	3.12	0	0.00
50% FPC practiced	3	0.44	0	0.00	62	9.21	0	0.00
60% FPC practiced	0	0.00	20	55.56	0	0.00	0	0.00
70% FPC practiced	1	0.15	16	44.44	100	14.86	0	0.00
80% FPC practiced	0	0.00	0	0.00	413	61.37	60	100.00
Care of baby after discharge Primary								
Breastfeed danger sign	28	4.06	0	0.00	0	0.00	0.00	0.00
KMC & breastfeed	588	85.34	17	47.22	517	76.82	22	36.67
NR	0	0.00	19	52.78	53	7.88	38	63.33
Check for any danger	73	10.60	0	0.00	103	15.30	0	0.00
Care baby after Discharge Secondary								
Breastfeed child/Fever	543	78.81	1	2.78	35	5.20	0	0.00
FPC	14	2.03	0	0.00	0	0.00	0	0.00
FPC_KMC	14	2.03	0	0.00	0	0.00	0	0.00
Hygiene, regularly ha	83	12.05	0	0.00	69	10.25	0	0.00
KMC	27	3.92	35	97.22	569	84.55	60	100.00
Proper food	8	1.16	0	0.00	0	0.00	0.00	0.00
Heard about FPC								
NR	0	0.00	20	55.56	0	0.00	38	63.33
No	6	0.87	0	0.00	248	36.85	0	0.00
No, But, heard about KMC	327	47.46	16	44.44	314	46.66	22	36.67
Yes	356	51.67	0	0.00	111	16.49	0	0.00
Received Training to take care of baby								
No	4	0.58	29	80.56	562	83.51	45	75.00
Yes	685	99.42	7	19.44	111	16.49	15	25.00
Family Member received FPC training								

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Table 3 continued

Father/Mother/Mother-	685	99.42	0	0.00	76	11.29	0	0.00
NR	0	0.00	20	55.56	1	0.15	38	63.33
No one	4	0.58	0	0.00	261	38.78	0	0.00
Only me	0	0.00	16	44.44	335	49.78	22	36.67
Observe Newborn Kept Clean								
NA	0	0.00	36	100.00	0	0.00	0	0.00
No	55	7.98	0	0.00	70	10.40	9	15.00
Yes	634	92.02	0	0.00	603	89.60	51	85.00
Total	**689**	**100**	**36**	**100**	**673**	100	**60**	**100.0**

Table 4. Tests of Association on Selected Independent Variables

Description	Nalanda				Total	p-value	Vaishali				Total	p-value
	Alive		Dead				Alive		Dead			
	n	%	n	%			n	%	n	%		
Age at marriage												
Less than 18	168	84.00	32	16.00	200		173	87.82	24	12.18	197	0.022
18 and above	521	99.24	4	0.76	525	0.000	500	93.28	36	6.72	536	
Education of mother (years of schooling)												
<=10	514	95.01	27	4.99	541		614	91.23	59	8.77	673	0.051
11-20	175	95.11	9	4.89	184	0.957	59	98.33	1	1.67	60	
BMI of mother												
Underweight	22	81.48	5	18.52	27		136	97.84	3	2.16	139	
Normal	615	95.50	29	4.50	644	0.013	501	90.43	53	9.57	554	0.006
Overweight	52	96.30	2	3.70	54		36	90.00	4	10.00	40	
Mother had any health issues during delivery												
No issue	582	96.36	22	3.64	604		635	92.03	55	7.97	690	0.386
Yes	107	88.43	14	11.57	121	0.001	38	88.37	5	11.63	43	
Received training for taking care of baby												
No	4	12.12	29	87.88	33		562	92.59	45	7.41	607	0.107
Yes	685	98.99	7	1.01	692	0.000	111	88.10	15	11.90	126	
No. of time pregnancy checked												
Once every trimester	614	94.61	35	5.39	649		591	91.63	54	8.37	645	0.835
less than 3 times	75	98.68	1	1.32	76	0.163	82	93.18	6	6.82	88	
Mode of delivery												
Normal	618	95.67	28	4.33	646		622	92.42	51	7.58	673	
C-section	34	89.47	4	10.53	38	0.051	38	88.37	5	11.63	43	0.041
Assisted	37	90.24	4	9.76	41		13	76.47	4	23.53	17	
Preterm baby												
No	598	96.76	20	3.24	618		562	93.51	39	6.49	601	0.001
Yes	91	85.05	16	14.95	107	0.000	111	84.09	21	15.91	132	
Birth weight												
<2.5	360	93.99	23	6.01	383		340	88.77	43	11.23	383	0.002
>=2.5	329	96.20	13	3.80	342	0.230	333	95.14	17	4.86	350	
Faced complications during delivery												
No	636	97.55	16	2.45	652		363	92.13	31	7.87	394	0.788
Yes	53	72.60	20	27.40	73	0.000	310	91.45	29	8.55	339	
FPC practiced												

Continued on next page

Table 4 continued

10%_20%	110	87.30	16	12.70	126	0.000	103	78.63	28	21.37	131	0.000
30%_40%	210	95.89	9	4.11	219		215	93.48	15	6.52	230	
50%_80%	369	97.11	11	2.89	380		355	95.43	17	4.57	372	
Total	**689**	**95.03**	**36**	**4.97**	**725**		**673**	**91.81**	**60**	**8.19**	**733**	

Note: * <0.05, **<0.01, *<0.000**

Table 5. Survival Outcome by Key Newborn Indicators

Independent variable	Survival outcome of newborn		df	X2	p-value
	Alive	Dead			
	n(%)	n(%)			
Baby's age					
31d-40d	414(30.40%)	86(89.58%)	1	139.418	0.000*
40d-50d	948(69.60%)	10(10.42%)			
Gender					
Male	866(63.58%)	64(66.67%)	1	0.369	0.543
Female	496(36.42%)	32(33.33%)			
Caste					
General	124(9.10%)	5(5.21%)	3	2.225	0.527
OBC	827(60.72%)	61(63.54%)			
ST	7(0.51%)	0(0%)			
SC	404(29.66%)	30(31.25%)			
Total	1362(100%)	96(100%)			

The chi-square test was used to understand the difference in survival outcome of newborns by newborn's age, gender, and caste. So, a significantly (p<0.001) higher percentage of deaths was observed among neonates aged 30 to 40 days (89.58%, n=86) compared to neonates aged 40 to 50 days (10.42%, n=10).

4 Discussion

There is ample evidence that there is an effect of FPC on a reduced length of stay at the facility, positive newborn growth, favorable survival outcomes of sick neonates, (especially in the case of newborns who received Kangaroo mother care and exclusive breastfeeding. FPC has been proven to be effective against neonatal mortality. FPC must be practiced in all SNCUs with a focus on family involvement as mothers are the sole attendant in most cases in SNCUs. Mothers were found to be the sole attendants of newborns getting discharged from SNCU and at households of the newborns till 30 days of life. One to two female family members accompanied her, mostly her mother-in-law or mother or sister-in-law would be present as additional caregivers at both places. Father's involvement was found negligible in our study.

Findings from observation of facilities revealed that both the facilities/SNCUs were well equipped in terms of resources to implement FPC. Vaishali mothers were counseled on the practice of KMC and hand hygiene particularly applying oil and not bathing the newborn. Variations in FPC practice made a difference in a newborn's morbidity status or mortality.[19] Common findings from secondary data analysis showed that at the facility level, most newborns admitted in SNCUs were in-borns while critical out-born newborns were admitted in very small numbers. No variation in the quality of care was captured based on secondary data from the last 12 months and through primary data. Most newborn mothers with caregivers came for follow-up visits on day 15 unless there was an emergency as instructed by both the SNCUs. Most mothers of newborns interviewed had been asked to come for follow-up on day 8 (which adheres to the requirement of follow-up on the 7th day) but very few came on day 8 or at the end of 1st month.[20–22]

11 key factors attributing to newborn survival status were identified in this study. Family Participatory care was identified as one of the integral factors contributing to newborn survival. Other factors affecting newborn survival status that had an association with survival status were the mother's health issue during delivery, maternal characteristics such as maternal age at marriage, maternal education (years of schooling), maternal body mass index, number of ANC visits, Mode of delivery(normal, C-section, Assisted), newborn's condition (preterm, Birth weight (LBW) and faced complication during delivery.[23]

5 Conclusion

This study has investigated the individual side, facility level side as well as household level side attributes of newborn survival. The study attempted to highlight some sociocultural attributes, perhaps in conjunction with the health care delivery system, that become instrumental in determining newborn health outcomes.

The study has found that there is a difference in the proportion of newborn deaths in the district that adopted family-participatory care and the district that did not adopt Family family-participatory care (FPC). Newborn death was almost double in Vaishali (district without FPC) as compared to Nalanda (district with FPC). The socio-economic characteristics of the sampled newborn households in study districts of Nalanda and Vaishali like the income of the household, and separate rooms for newborns had an association with newborn deaths. There is an association of survival outcome (of sick neonates) with socioeconomic variables and maternal characteristics such as maternal age, maternal education, family income, maternal body mass index, and health status of the mother. Government programs targeted to ensuring newborn survival at the facility level and community level along with supportive services in economically backward families and nutritional uptake of pregnant mothers will ensure a reduction in the probability of newborn death.

The study emphasizes the need to strengthen the existing policies targeted for the readiness of mothers such as age at marriage, girl education, girl nutritional intake, and Care during pregnancy like strict adherence to ANC visits and birth preparedness. The study also emphasizes the need to strengthen the practices of FPC through existing facility-based newborn care and home-based newborn care guidelines and policies targeted at improving newborn's weight and survival.

Ethical Clearance

The ethical approval has been taken from the Ethical Board, IIHMR University, Jaipur. Informed consent was taken from each of the respondents pertaining to their voluntary participation, right to withdraw from the interview at any point of time during the interview, confidentiality, and privacy of collected.

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