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Reasons of Infant Mortality (Except Neonates) in Patients Admitted in Tertiary Care Hospital, Bhavnagar: A Cross-Sectional Study.

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Abstract

Background: Infant deaths between 29 days and 12 months of age contribute significantly to child mortality in India. Data on the distribution of causative factors among such deaths at tertiary care level in Gujarat remain limited. Objective: This study aimed at evaluating proportion of various factors/ causes directly or indirectly responsible for infant mortality in patients admitted in a tertiary care hospital and accordingly suggest strategies for reducing infant mortality in the region. ***Methods***: A hospital-based retrospective cross-sectional study was conducted in the Department of Paediatrics. All 64 infant deaths reviewed by the Departmental Monthly Death Review Committee during the one-year study period were included. Neonates and infants brought dead were excluded. Gender, gestational age, nutritional status, socioeconomic status, immunization coverage, parental education, maternal age, birth order, and causes of death were studied. ***Results***: Of 64 deaths, 57.8% were male. Preterm infants accounted for 81.25% of deaths. Severe Acute Malnutrition was present in 34.38% and underweight status in 39.06% of cases; only 12.5% were well nourished. About 75% of deaths occurred in families from the lower socioeconomic class. Only 26.56% were fully immunized, while 54.69% were partially and 18.75% were completely unimmunized. Deaths were most common in third or higher birth order infants (48.44%) and in mothers aged 18 to 25 years (40.63%). The most common contributing causes were low birth weight with prematurity (81.25%), sepsis (68.75%), and respiratory tract infections (51.56%). Prior NICU admission was recorded in 82.81% of cases. ***Conclusion***: Most infant deaths occurred in preterm, malnourished infants from poor families with inadequate immunization and low parental education. The majority of causes are preventable. Improving antenatal care, nutritional screening, immunization outreach, and post-discharge follow-up for high-risk infants are essential to reduce infant mortality in this setting.

Keywords: infant mortality, malnutrition, prematurity, immunization, socioeconomic status, death review.

INTRODUCTION

Infant mortality, defined as death before completion of the first year of life, is an important indicator of population health and reflects socioeconomic, nutritional, environmental, and healthcare conditions [1]. The Infant Mortality Rate (IMR), expressed as the number of infant deaths per 1,000 live births, is widely used to assess child survival and the effectiveness of maternal and child health services [1]. Infant survival is influenced by factors operating from pregnancy through early childhood, including access to healthcare, maternal education, nutrition, and living conditions. [1-3]

India has achieved considerable reductions in child mortality over recent decades; however, substantial disparities persist across socioeconomic and geographical groups [4]. UNICEF reported approximately 468,000 neonatal deaths in India in 2020, emphasizing the continuing need for effective interventions during the antenatal, intrapartum, neonatal, and early

infancy periods [5]. Prematurity, low birth weight, birth asphyxia, neonatal infections, congenital anomalies, respiratory infections, and diarrhoeal diseases are important contributors to infant mortality [5,6]. These outcomes are further influenced by maternal age, birth order, socioeconomic status, maternal education, nutrition, immunization, and access to healthcare [6,7].

Hospital-based studies provide an opportunity to evaluate clinical and social factors associated with infant mortality through systematic review of medical records. [8-10] Tertiary-care hospitals, which serve diverse urban and rural populations, are particularly useful for identifying potentially modifiable determinants and guiding targeted interventions. [8-10]

Sir Takhtsinhji General Hospital, Bhavnagar, is a government tertiary-care teaching hospital and major paediatric referral centre serving urban and rural populations. Its Departmental Monthly Death Review Committee provides a systematic mechanism for reviewing paediatric deaths and identifying contributing factors. Therefore, the present study was undertaken to assess the nutritional status, socioeconomic characteristics, immunization status, and parental educational status among infants who died during hospitalization, along with selected demographic and clinical factors, to identify potentially modifiable determinants and inform strategies for reducing infant mortality in the region.

MATERIALS AND METHODS

Study Design and setting

The present study was a hospital-based retrospective cross-sectional observational study conducted in the Department of Paediatrics, Sir Takhtsinhji General Hospital, Bhavnagar, Gujarat, a government tertiary-care teaching hospital affiliated with Government Medical College, Bhavnagar. A retrospective design was adopted as the study utilized existing hospital records and documentation from the Departmental Monthly Death Review Committee. The cross-sectional approach was appropriate for assessing the distribution of study variables among infant deaths during the defined study period, without any intervention. All patients had received standard medical care according to institutional protocols, and no additional diagnostic or therapeutic interventions were undertaken for the purpose of the study.

Study Duration

The study was conducted over a period of one year, followed by one month for data compilation, analysis, and interpretation.

Study Population

The study population comprised infants aged 29 days to less than 12 months who died during admission in the paediatric wards or PICU of Sir Takhtsinhji General Hospital during the study period. Eligible cases were reviewed and documented during the Departmental Monthly Death Review Committee meetings.

Sample Size

All eligible infant deaths occurring during the study period were included in the study. As a complete enumeration of eligible cases was undertaken, no formal sample size calculation was performed. A total of 64 infant death case records were included in the final analysis.

Inclusion Criteria

- Infants aged 29 days to less than 12 months who died during hospitalization in the paediatric wards or PICU.
- Infant deaths reviewed and documented by the Departmental Monthly Death Review Committee.

Exclusion Criteria

- Neonates aged less than 28 completed days.
- Infants brought dead to the hospital.
- Cases with incomplete medical records or insufficient documentation to assess the study variables.

Data Collection

Prior approval was obtained from the Institutional Ethics Committee before commencement of data collection. Data were retrospectively collected using a structured, pre-approved data collection proforma. Information was obtained from inpatient case records, treatment charts, investigation reports, discharge summaries, death summaries, and records of the Departmental Monthly Death Review Committee.

The variables assessed included demographic characteristics, clinical history, nutritional status, immunization status, socioeconomic status, parental education, relevant birth history, and cause of death. Data were collected by the principal

investigator using paper-based case record forms and subsequently entered into a Microsoft Excel master database. The entries were reviewed for completeness and accuracy, and cross-verification was performed to minimize data-entry errors.

Variables Studied

The principal study variables included nutritional status, socioeconomic status, immunization status, gestational age at birth, birth order, and maternal age. Additional variables included sex of the infant, maternal and paternal educational status, weight-for-age percentile, past medical history, family history, and primary cause of death. The outcome measure was the distribution of infant deaths according to these characteristics.

Statistical Analysis:

Data were entered into Microsoft Excel and analysed using Microsoft Excel. Categorical variables were summarized using frequencies and percentages. The findings were presented in appropriate tables and figures for descriptive analysis.

RESULTS

Table 1. Demographic distribution and infant death parameters of the study

Parameters			Number of Infant	Percentage
Gender	Male		37	57.8%
	Female		27	42.2%
Nutritional Status	Well nourished	Well nourished	08	12.5%
	Under nourished	Stunting (Chronic Malnutrition)	01	1.56%
		Moderate Acute Malnutrition (Wasting)	07	10.94%
		Severe Acute Malnutrition (Wasting)	22	34.38%
		Under weight	25	39.06%
	Over nourished	Over weight	01	1.56%
		Obesity	00	0%
Gestational Age of Infant at death	Extreme Preterm		03	4.69%
	Early Preterm		16	25%
	Moderate Preterm		19	29.69%
	Late Preterm		14	21.88%
	Full Term		12	18.75%
	Post term		00	0%
Weight-for-Age Classification	<3rd percentile		47	73.44%
	3^{rd} – 10^{th} percentile		3	4.69%
	10^{th} –25^{th} percentile		8	12.5%
	25^{th} –50^{th} percentile		2	3.13%
	50^{th} –97^{th} percentile		4	6.25%
Socioeconomic Profile (Modified B.G Prasad Classification)	Upper		0	0%
	Upper Middle		0	0%
	Middle		2	3.13%
	Lower Middle		14	21.88%
	Lower		48	75%

Table 1 summarizes the demographic and clinical characteristics of infant deaths. A slight male predominance was observed (57.8%). Undernutrition was common, with 39.06% of infants being underweight, 34.38% having severe acute malnutrition, and 73.44% having weight-for-age below the 3rd percentile. Most deaths occurred among preterm infants, particularly moderately preterm (29.69%) and early preterm (25%). Additionally, 75% of deaths occurred among infants from the lower socioeconomic class and 21.88% from the lower-middle class, indicating a substantial burden of mortality among socioeconomically disadvantaged and nutritionally vulnerable infants.

Table 2. Distribution of Infant death by various demographic and clinical parameters

Distribution of Infant deaths based on		Number of Infant	Percentage
Maternal Education	Illiterate	23	35.94%
	Primary	17	26.56%
	Secondary	17	26.56%
	Higher secondary	5	7.81%
	Graduate	2	3.13%
Paternal Education	Illiterate	6	9.38%
	Primary	12	18.75%
	Secondary	19	29.69%
	Higher secondary	20	31.25%
	Graduate	7	10.94%
Age Appropriate-Immunization Status	Unimmunized	12	18.75%
	Partially Immunized	35	54.69%
	Fully Immunized	17	26.56%
Maternal Age	<18 years	0	00%
	18–25 years	26	40.63%
	26–30 years	22	34.38%
	>30 years	16	25%
Birth Order	First Born	10	15.62%
	Second Born	23	35.94%
	Third or higher order	31	48.44%
Past medical & Family history	NICU Admission	53	82.81%
	Previous Hospitalization	22	34.38%
	Any Illness/Disease	39	60.94%
	Family Disorder	6	9.37%

Table 2 shows that 35.94% of mothers were illiterate, while paternal education was relatively higher, with 29.69% having secondary and 31.25% higher secondary education. Inadequate immunization was common, with 54.69% partially immunized and 18.75% unimmunized.

The highest proportion of deaths occurred among mothers aged 18–25 years (40.63%), while 48.44% occurred among third or higher-order births. Additionally, 82.81% of infants had a previous NICU admission and 60.94% had a history of prior illness, indicating a high-risk population requiring close follow-up and appropriate post-discharge care.

Table 3. Cause of death in Infant Mortality

Cause of Death	Number	Percentage
Low birth weight & Prematurity	52	81.25%
Birth Asphyxia & Difficult Labour	1	1.56%
Sepsis	44	68.75%
Congenital Anomalies	14	21.88%
Respiratory Tract Infections	33	51.56%
Diarrheal Diseases	4	6.25%
Others	25	39.06%

Table 3 demonstrates that low birth weight and prematurity were the most frequently identified causes associated with infant mortality, accounting for 81.25% of deaths. Sepsis was reported in 68.75% of cases, followed by respiratory tract infections (51.56%).

Congenital anomalies contributed to 21.88% of deaths, while 6.25% were associated with diarrhoeal diseases. Birth asphyxia and difficult labour accounted for 1.56% of deaths, whereas 39.06% were attributed to other causes. Overall, the findings indicate that prematurity, low birth weight, sepsis, and respiratory tract infections constituted the predominant contributors to infant mortality in the study population.

Table 4. Association of Immunisation status with different clinical parameters

Association between Immunization Status and RTI			
Immunization Status	**RTI Present**	**RTI Absent**	**Total**
Unimmunized	9 (75%)	3 (25%)	12
Partially Immunized	12 (34.3%)	23 (65.7%)	35
Fully Immunized	6 (35.3%)	11 (64.7%)	17
Association Between Immunization Status and Sepsis			
Immunization Status	**Sepsis Present**	**Sepsis Absent**	**Total**
Unimmunized	10 (83.3%)	2 (16.7%)	12
Partially Immunized	24 (68.6%)	11 (31.4%)	35
Fully Immunized	10 (58.8%)	7 (41.2%)	17
Association of Infant Immunization Status with Parental Education			
Parental Education	**Fully Immunized**	**Not Fully Immunized**	**Total**
Both Illiterate	2 (13.3%)	13 (86.7%)	15
One Illiterate	7 (28.0%)	18 (72.0%)	25
Both Literate	8 (33.3%)	16 (66.7%)	24

Table 4 demonstrates that RTI and sepsis were more frequently observed among unimmunized infants, occurring in 75.0% and 83.3%, respectively, compared with 35.3% and 58.8% among fully immunized infants. Full immunization was also more common among infants with both literate parents (33.3%) than among those with one illiterate (28.0%) or both illiterate parents (13.3%). These findings suggest an association between inadequate immunization, infectious morbidity, and lower parental educational status; however, causality cannot be established from this descriptive study.

Table 5. Relationship of various parameters with RTI and Sepsis among Infant mortality

Parameters		**Sepsis Present**	**RTI Present**
Birth Order	First Born (n=10)	6 (60.0%)	4 (40.0%)
	Second Born (n=23)	15 (65.2%)	10 (43.5%)
	≥ Third Born (n=31)	23 (74.2%)	19 (61.3%)
Gestational Age	Preterm (n=52)	38 (73.1%)	28 (53.85%)
	Term (n=12)	6 (50.0%)	5 (41.66%)

Table 5 shows that sepsis and RTI were more frequent among infants of higher birth order, with sepsis occurring in 60.0% of first-born, 65.2% of second-born, and 74.2% of third or higher-order infants. Similarly, RTI was present in 40.0%, 43.5%, and 61.3%, respectively. Preterm infants also had higher proportions of sepsis (73.1%) and RTI (53.85%) compared with term infants (50.0% and 41.66%, respectively). These findings suggest greater infectious vulnerability among preterm and higher-order infants, although causal relationships cannot be established from the present study.

Table 6. Distribution of Nutritional Status Across Socioeconomic Classes

Socioeconomic Status	Normal	Malnourished (Underweight + MAM + SAM + Stunting)	Total
Upper (n=0)	0	0	0
Upper Middle (n=0)	0	0	0
Middle (n=2)	1 (50.0%)	1 (50.0%)	2
Lower Middle (n=14)	2 (14.3%)	12 (85.7%)	14
Lower (n=48)	5 (10.4%)	43 (89.6%)	48
Total	8	56	64

Table 6 shows a high prevalence of malnutrition among the 64 infant deaths, with 56 (87.5%) classified as malnourished and only 8 (12.5%) having normal nutritional status. Malnutrition was particularly common among infants from the lower (89.6%) and lower-middle (85.7%) socioeconomic classes, compared with 50.0% in the middle class. No infants belonged to the upper or upper-middle classes. These findings indicate a substantial burden of malnutrition among deceased infants, particularly those from lower socioeconomic groups.

DISCUSSION

The present hospital-based retrospective cross-sectional study evaluated 64 infant deaths at Sir Takhtsinhji General Hospital, Bhavnagar, with respect to demographic, nutritional, socioeconomic, immunization, and clinical factors. A slight male predominance was observed (57.8%).

Undernutrition was highly prevalent, with 39.06% of infants being underweight, 34.38% having severe acute malnutrition, and 73.44% having weight-for-age below the 3rd percentile. Only 12.5% were adequately nourished. These findings highlight the important association between nutritional vulnerability and infant mortality. Black RE et al. estimated that undernutrition contributes to approximately 45% of under-five deaths globally [11], while Olofin I et al. reported nearly a nine-fold higher mortality risk among severely underweight children [12]. The bidirectional interaction between malnutrition and infection may further increase mortality risk [13].

A marked socioeconomic disparity was observed, with 75% of deaths occurring in the lower socioeconomic class and 21.88% in the lower-middle class. Additionally, 89.6% of infants from the lower socioeconomic class were malnourished compared with 50% from the middle class. These findings are consistent with studies demonstrating higher child mortality among economically disadvantaged populations [14,15].

Prematurity and low birth weight were prominent, with 81.25% of deaths occurring among preterm infants. Sepsis and RTI were also more frequent among preterm infants than term infants. The major contributing causes of death were low birth weight and prematurity (81.25%), sepsis (68.75%), and RTI (51.56%), followed by congenital anomalies (21.88%) and diarrhoeal diseases (6.25%). As multiple contributing causes could be present in an individual infant, these findings indicate a multifactorial pattern of mortality. The substantial burden of infection among preterm infants is consistent with their increased biological vulnerability and the recognized burden of respiratory infections in low- and middle-income countries [13,16].

Immunization coverage was inadequate, with only 26.56% of infants fully immunized, while 54.69% were partially immunized and 18.75% unimmunized. RTI and sepsis were proportionately higher among unimmunized infants (75% and 83.3%, respectively) than among fully immunized infants (35.3% and 58.8%). Although causality cannot be established, these findings highlight the importance of complete immunization in reducing infectious morbidity [17-19].
Parental education showed a positive association with immunization. Full immunization increased from 13.3% among infants with both parents illiterate to 33.3% when both parents were literate. Maternal illiteracy was observed in 35.94% of cases. Previous studies have similarly demonstrated the importance of maternal and paternal education in immunization uptake and child health outcomes [20,21].

Deaths were more frequent among mothers aged 18–25 years (40.63%) and among third or higher-order births (48.44%). Sepsis and RTI were also more common among higher-order births. These findings may reflect the influence of maternal age, birth spacing, maternal nutritional reserves, and distribution of household resources, although causal relationships cannot be established from the present study [22].

A history of NICU admission was present in 82.81%, while 60.94% had previous illness and 34.38% had previous hospitalization, indicating that many deceased infants were already at high risk. Previous studies have emphasized the vulnerability of low-birth-weight and NICU survivors to subsequent infections and readmission, highlighting the need for structured post-discharge follow-up [23,24].

Overall, infant mortality in this setting was characterized by the interplay of prematurity, undernutrition, socioeconomic disadvantage, incomplete immunization, and recurrent illness. Strengthening antenatal care, nutritional screening, immunization services, parental health education, and structured follow-up of high-risk infants may contribute to reducing preventable infant deaths [25].

CONCLUSION

Infant mortality in this study was predominantly associated with prematurity, low birth weight, malnutrition, infections, socioeconomic disadvantage, and inadequate immunization. Strengthening antenatal care, nutrition, immunization, hygiene & sanitation, parental education, and post-discharge follow-up of high-risk infants will definitely help reduce preventable infant deaths.

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