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Original Research Article

CLINICO-EPIDEMIOLOGICAL PROFILE AND OUTCOMES OF ACUTE SEVERE BRONCHIOLITIS IN CHILDREN UNDER TWO YEARS: A TERTIARY CARE HOSPITAL STUDY

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ABSTRACT

Background: Acute severe bronchiolitis represents a significant cause of pediatric hospitalization globally, with respiratory syncytial virus being the predominant pathogen. Comprehensive understanding of clinical characteristics and risk determinants remains crucial for optimizing therapeutic interventions. **Objective**: To characterize the clinical profile, identify risk determinants, and evaluate treatment outcomes in children under two years hospitalized with acute severe bronchiolitis.

Materials and Methods: This cross-sectional observational study encompassed 115 children aged 1-24 months admitted with acute severe bronchiolitis over 18 months (2023-2024) at a tertiary care center. Acute severe bronchiolitis was defined by clinical criteria including one or more of following conditions : 1)hypoxemia (SpO_2 ≤92%) not corrected by oxygen,2)need for mechanical ventilation ,3) severe respiratory distress with marked retractions ,nasal flaring,grunting ,4)Poor feeding/need for intravenous hydration.Comprehensive data collection included demographics, risk determinants, clinical manifestations, laboratory investigations, radiological findings, and therapeutic outcomes using descriptive statistical analysis.

Results: The cohort predominantly comprised infants aged 3-6 months (51.3%) with male preponderance (56.5%). Significant risk determinants included prematurity (40.0%), low birth weight <2.5 kg (60.0%), non-exclusive breastfeeding (43.5%), overcrowding (53.9%), and congenital heart disease (20.9%). The anthropometric assessment revealed that 30.4% of children fell within the normal weight-for-height range (median ±1 SD), whereas 49.5% exceeding +1 SD, indicating overweight or obesity and 20% have less than -1 SD indicating wasting. Universal clinical manifestations included wheezing (100%) and hypoxemia (100%), with frequent feeding difficulties (70.4%), fever (66.1%), and altered consciousness (irritability 52.2%, drowsiness 47.8%). Ventilatory support was necessitated in 60.9% of cases (non-invasive 50.4%, invasive 10.4%). Hypertonic saline nebulization was predominantly utilized (60.9%). Mean hospitalization duration was 4.27 ± 1.19 days, achieving 98.3% discharge rate with 1.7% mortality.

Conclusion: Acute severe bronchiolitis predominantly affects infants aged 3–6 months with both modifiable and non-modifiable risk factors. Notably, nearly half of cohort demonstrated overweight or obese ,suggesting that both undernutrition and overnutrition may influence disease severity and warrant targeted nutritional interventions. High ventilatory support requirements underscore the importance of tertiary care, while favorable discharge rates demonstrate effective management. Preventive strategies—such as Nirsevimab and Palivizumab immunoprophylaxis in high-risk infants—alongside

promotion of exclusive breastfeeding and environmental risk reduction, are essential to mitigate RSV disease burden.
Keywords: Bronchiolitis, Respiratory Syncytial Virus, Infants, Risk Factors, Clinical Outcomes.

INTRODUCTION

Bronchiolitis, predominantly caused by respiratory syncytial virus (RSV), constitutes a leading cause of lower respiratory tract infections in children under two years, frequently necessitating hospitalization in severe presentations.[1,2] Severe bronchiolitis is characterized by hypoxemia, respiratory distress, feeding difficulties, or requirement for ventilatory support.[3] Multiple risk determinants have been identified, including prematurity, low birth weight, congenital heart disease, non-exclusive breastfeeding, overcrowding, and passive smoking exposure.[4,5] Clinical manifestations range from mild wheezing to life-threatening respiratory failure, necessitating early recognition and supportive management encompassing oxygen therapy, nebulization, and mechanical ventilation.[6] Seasonal epidemiological patterns typically demonstrate winter peaks corresponding to RSV circulation.[7]

This investigation aims to characterize the comprehensive clinico-epidemiological profile, risk determinants, and treatment outcomes of acute severe bronchiolitis in children under two years admitted to a tertiary care center, providing evidence for enhanced clinical practice and prevention strategies.

MATERIALS AND METHODS

Methods

This cross-sectional observational study was conducted over 18 months (2023-2024) in pediatric wards and intensive care units of a tertiary healthcare center at Indore, Madhya Pradesh, India.

Inclusion criteria included children aged 1-24 months presenting with symptoms of severe bronchiolitis accompanied by at least one of the following: inadequate oral intake necessitating intravenous hydration; pronounced respiratory distress evidenced by marked chest retractions, nasal flaring, or grunting; hypoxemia unresponsive to supplemental oxygen (SpO_2 < 92%); or requirement for mechanical ventilatory support. Exclusion criteria included chest radiographic findings suggesting non-bronchiolitis pathology and parental refusal for participation. Sample size calculation using Cochran's formula (p=5%, q=95%, margin of error=5%) yielded 76 participants, though 115 eligible patients were enrolled through convenience sampling.

Comprehensive data acquisition involved medical records review, clinical examinations, and parental interviews using standardized proformas. Variables encompassed demographics, birth history, feeding practices, family history of respiratory infections, clinical manifestations, laboratory investigations, radiological findings, therapeutic interventions, and clinical outcomes.

Data were entered into Microsoft Excel 2016 and analyzed using descriptive statistics, presented as frequencies, percentages, means, and standard deviations with tabular and graphical representations.

RESULTS

The study cohort comprised 115 children, with the majority (51.3%) in the 3-6 months age group, demonstrating peak vulnerability during early infancy. Male predominance was observed (56.5%) with a male: female ratio of 1.3:1. Low birth weight (<2.5 kg) affected 60.0% of cases, while prematurity was documented in 40.0%. Cesarean delivery occurred in 56.5% of births. Socioeconomic distribution revealed higher prevalence among middle class (33.9%) and lower middle class (29.6%) families. [Table 1]

Significant environmental risk factors included overcrowding (53.9%), family history of upper respiratory tract infections (49.6%), and non-exclusive breastfeeding (43.5%). Passive smoking exposure affected 26.1% of cases. Comorbid conditions comprised congenital heart disease (20.9%), history of neonatal mechanical ventilation (14.8%), and chronic pulmonary disease/airway anomalies (12.2%). Seasonal analysis revealed peak incidence during December-January (38.3% of cases). [Table 2 and Figure 1]

The anthropometric assessment revealed that 30.4% of children fell within the normal weight-for-height range (median ±1 SD), whereas 49.5% exceeding +1 SD, indicating overweight or obesity and 20% have less than -1 SD indicating wasting[Table 3]

Universal clinical manifestations included wheezing (100%) and hypoxemia with SpO_2 ≤95% (100%). Feeding difficulties were reported in 70.4% of cases, fever in 66.1%. Altered consciousness presented as irritability (52.2%) and drowsiness (47.8%). Severe respiratory distress indicators included cyanosis (27.8%), head bobbing (25.2%), and apnea (3.5%). Laboratory investigations revealed anemia in 47.0% of cases with lymphocyte predominance (88.0%) supporting viral etiology. Elevated C-reactive protein (27.8%) suggested bacterial co-infection in a subset. Radiological findings demonstrated hyperinflation (62.6%) as the predominant pattern. [Table 4]

Ventilatory support was required in 60.9% of cases, with non-invasive ventilation utilized in 50.4% and invasive mechanical ventilation in 10.4%. Hypertonic saline nebulization was the predominant

therapy (60.9%), followed by salbutamol (22.6%) and budesonide (16.5%). Mean hospitalization duration was 4.27 ± 1.19 days, with 58.3% requiring 4-5 days admission. Excellent clinical outcomes were achieved with 98.3% discharge rate and 1.7% mortality (Table 5 and Figure 2).

Table 1: Baseline Socio-demographic Characteristics of Study Participants (n=115)

Characteristic	Frequency (%)
Age groups (months)	
<3 months	1 (0.9)
3-6 months	59 (51.3)
6-12 months	35 (30.4)
>12 months	20 (17.4)
Sex	
Male	65 (56.5)
Female	50 (43.5)
Birth weight	
<2.5 kg	69 (60.0)
≥2.5 kg	46 (40.0)
Gestational age	
Preterm	46 (40.0)
Term	63 (54.8)
Post-term	6 (5.2)
Mode of delivery	
Cesarean section	65 (56.5)
Vaginal delivery	50 (43.5)
Socioeconomic status	
Upper class	5 (4.3)
Upper middle class	14 (12.2)
Middle class	39 (33.9)
Lower middle class	34 (29.6)
Lower class	23 (20.0)

Table 2: Risk Factors and Environmental Exposures (n=115)

Risk Factors	Frequency (%)
Non-exclusive breastfeeding	50 (43.5)
Overcrowding	62 (53.9)
Passive smoking exposure	30 (26.1)
History of neonatal ventilation	17 (14.8)
Congenital heart disease	24 (20.9)
Chronic pulmonary disease/airway anomaly	14 (12.2)
Family history of URTI	57 (49.6)
Seasonal distribution	
Peak months (December-January)	44 (38.3)
Other months	71 (61.7)

Table 3: Distribution according to weight for height (Z score) (n=115)

Weight-for-Height (Z score)	Frequency (%)
< –3 SD (severe wasting)	10 (8.7)
–3 SD to –2 SD (moderate wasting)	5 (4.3)
–2 SD to –1 SD (mild wasting)	8 (7.0)
–1 SD to median	9 (7.8)
Median	12 (10.4)
Median to +1 SD	14 (12.2)
+1 SD to +2 SD(overweight)	22 (19.1)
+2 SD to +3 SD(overweight)	20 (17.4)
> +3 SD (obese)	15 (13.0)

Table 4: Clinical Presentation and Diagnostic Findings (n=115)

Clinical Features	Frequency (%)
Wheezing	115 (100.0)
Hypoxemia (SpO_2 ≤95%)	115 (100.0)
Refusal to feed	81 (70.4)
Fever	76 (66.1)
Altered sensorium	
Irritability	60 (52.2)
Drowsiness	55 (47.8)
Reduced air entry	46 (40.0)
Cyanosis	32 (27.8)
Head bobbing	29 (25.2)
Apnea	4 (3.5)
Laboratory findings	

Anemia (any grade)	54 (47.0)
Lymphocyte predominance	101 (88.0)
Elevated CRP	32 (27.8)
Radiological findings	
Hyperinflation	72 (62.6)
Peri bronchial thickening	32 (27.8)
Patchy atelectasis	11 (9.6)

Table 5: Treatment Modalities and Clinical Outcomes (n=115)

Treatment and Outcomes	Frequency (%)
Ventilatory support	
Non-invasive ventilation	58 (50.4)
Invasive ventilation	12 (10.4)
No ventilation required	45 (39.1)
Nebulization therapy	
Hypertonic saline (3% NaCl)	70 (60.9)
Salbutamol	26 (22.6)
Budesonide	19 (16.5)
Hospital stay duration	
Mean duration (days)	4.27 ± 1.19
4-5 days	67 (58.3)
>5 days	16 (13.9)
Final outcomes	
Discharged	113 (98.3)
Mortality	2 (1.7)

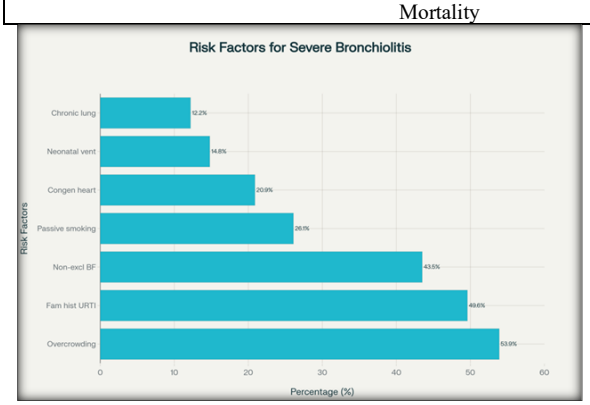

Figure 1: Prevalence of Major Risk Factors in Acute Severe Bronchiolitis (n=115)

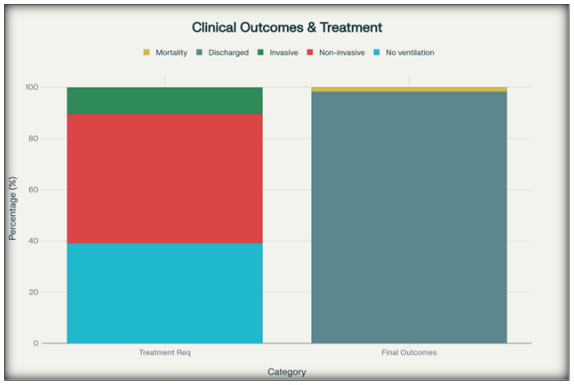

Figure 2: Treatment Requirements and Clinical Outcomes in Acute Severe Bronchiolitis (n=115)

DISCUSSION

The present study provides detailed clinico-epidemiological insights into acute severe bronchiolitis in 115 children under two years at a tertiary care facility, revealing significant patterns in age distribution, risk determinants, and clinical outcomes.

The predominance of cases in the 3-6 months age group (51.3%) aligns with Voets et al., who demonstrated age <6 months as a hospitalization predictor (sensitivity 62%, specificity 72%, relative risk 2.68), attributed to immature immune responses and smaller airway diameters limiting effective viral clearance.[8] The observed male preponderance (male: female ratio 1.3:1) corroborates findings by Iqbal et al. and Tian et al., potentially reflecting sex-specific differences in lung development and airway caliber, with males having relatively narrower airways, increasing obstruction risk.[9,10]

The substantial prevalence of low birth weight (60.0%) and prematurity (40.0%) as risk determinants aligns with Sala et al., who associated prematurity with intensive care admission (odds ratio 1.7) and Koehoorn et al., reflecting underdeveloped pulmonary function and compromised immune capacity.[11,12] The high cesarean delivery rate (56.5%) corresponds with Douglas et al., who reported increased bronchiolitis risk with elective cesarean sections (odds ratio 1.35-1.37), potentially due to altered microbiome development affecting immune priming.[13]

Non-exclusive breastfeeding (43.5%) and passive smoking (26.1%) emerged as modifiable risk determinants, supported by Sanghavi et al. and Robledo-Aceves et al., respectively, emphasizing protective immunoglobulin transfer and tobacco smoke-induced respiratory impairment.[14,15]

Congenital heart disease (20.9%) and neonatal mechanical ventilation (14.8%) were notable risk factors, with the latter less frequently reported but plausible due to lung injury from barotrauma, increasing susceptibility to severe infections.[6]

Environmental risk factors demonstrated significant impact, with overcrowding (53.9%) and family history of upper respiratory tract infections (49.6%) highlighting household transmission dynamics,

consistent with Atay et al., emphasizing the need for household hygiene interventions.[16]

The universal presence of wheezing (100%) and hypoxemia (100%) reflects severe phenotypic presentation, while frequent feeding difficulties (70.4%), fever (66.1%) and altered consciousness (irritability 52.2%) indicate systemic involvement. Hypoxemia results from ventilation-perfusion mismatch due to bronchiolar obstruction, while altered sensorium may stem from hypoxia or systemic inflammation.[7] The substantial ventilatory support requirement (60.9%, 50.4% non-invasive) exceeds previous reports by Malik et al. (18.75%), likely reflecting tertiary care referral patterns and disease severity.[18]

Hypertonic saline nebulization predominance (60.9%) reflects evidence-based practice for reducing airway edema, as supported by Malik et al., though salbutamol usage (22.6%) exceeds guideline recommendations, suggesting institutional practice variations.[18,9] The favorable outcomes with 98.3% discharge rate and 1.7% mortality demonstrate effective management protocols that are comparable with Al Shibli et al. (0% mortality), with deaths associated with comorbidities like CHD and bacterial co-infections (CRP positive: 27.8%).[19]

Study strengths include comprehensive tertiary care data collection and identification of novel risk factors. Study limitations include single-center design restricting generalizability and absence of virological confirmation, though lymphocyte predominance (88.0%) supports a viral aetiology.[1] Absence of long-term follow-up restricts insights into sequelae like recurrent wheezing, noted by Törmänen et al.[20] Future multicenter investigations with virological testing and longitudinal follow-up are warranted to enhance etiological precision and assess long-term outcomes. Statistical modeling (e.g., logistic regression) could clarify predictors of severity, such as apnea or cyanosis, to inform risk stratification.

CONCLUSION

This comprehensive analysis of 115 hospitalized children under two years demonstrates that severe bronchiolitis chiefly impacts infants aged 3–6 months, with prematurity, low birth weight, and environmental exposures serving as significant risk determinants. The cohort exhibited a bimodal nutritional profile, with 49.5% of children showing overweight/obese and 20% showing wasting, underscoring the dual importance of addressing both undernutrition and excessive weight in comprehensive bronchiolitis management. Universal hypoxemia and substantial ventilatory needs highlight the critical role of tertiary care in achieving a 98.3% discharge rate. Integrating targeted RSV prophylaxis—Nirsevimab (Beyfortus) for broad seasonal protection and Palivizumab (Synagis) for infants with specific high-risk conditions—alongside strategies to promote exclusive breastfeeding, reduce household smoke exposure, and alleviate overcrowding, will be pivotal in reducing severe bronchiolitis incidence and improving pediatric respiratory health.

Recommendations

Early identification of high-risk infants enables targeted interventions including RSV prophylaxis, while addressing modifiable risk factors through breastfeeding promotion, smoking cessation, and improved living conditions could substantially reduce disease burden.

Relevance

This study provides essential evidence for optimizing bronchiolitis management protocols and prevention strategies in resource-limited settings, particularly relevant for developing healthcare systems.

Authors' Contribution

All authors contributed substantially to study conception, data collection, analysis, and manuscript preparation, with equal responsibility for content accuracy and integrity.

Ethical Considerations

Institutional Ethics Committee approval was obtained prior to study initiation. Written informed consent was secured from all participants' parents/guardians, ensuring confidentiality and ethical compliance.

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Conflicts of Interest

The authors declare no competing interests or conflicts related to this research.

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