

Predicting Factors of Bronchiolitis in Children Admitted To P. I.C.U At the Jala Children's Hospital, Tripoli, Libya

Faraj A Ahamed¹, Marwa H Sasi¹, Aisha A Sehri².

1. University Hospital, Tripoli, Libya.
2. Faculty of Medicine University, of Tripoli, Tripoli, Libya.

ABSTRACT

Bronchiolitis is a common viral lower respiratory tract infection in children under two years of age. It is associated with high morbidity, frequent hospitalizations, and increased healthcare costs, although mortality remains low. Aim: To identify clinical predictors of Pediatric Intensive Care Unit (PICU) admission among children diagnosed with bronchiolitis. Methods: A retrospective review was conducted of all pediatric files with a diagnosis of bronchiolitis at Jala Children's Hospital, Tripoli, Libya, between 1 October 2018 and 31 March 2019. Data were collected using a structured questionnaire, including demographic, clinical, and laboratory variables. Children admitted to the general pediatric ward were compared with those admitted to the PICU. Results: Ninety children met the inclusion criteria. The median age was 62.5 days (IQR 45–120), and 62.2% were male. Of these, 60% were admitted to the regular ward, while 40% required PICU care. Significant predictors of PICU admission included formula feeding (72.2% vs. 22.2%; $p = 0.015$), higher respiratory rate (65.5 ± 6.78 vs. 53.5 ± 7.75 breaths/min; $p < 0.001$), and lower room-air oxygen saturation (86.6 ± 5.98 vs. 93.1 ± 3.71 ; $p = 0.012$). Other factors—such as age, sex, family history of asthma, eczema, birth weight, heart rate, and chest X-ray findings—were not significantly associated with PICU admission. Conclusion: Formula feeding, elevated respiratory rate, and decreased oxygen saturation were key predictors of PICU admission in children with bronchiolitis. These findings emphasize the need to develop standardized guidelines and protocols for PICU admission in the hospital's emergency department.

KEYWORDS: Bronchiolitis, children, morbidity.

INTRODUCTION

Respiratory tract infections (RTIs) occur when infectious agents affect any part of the respiratory system, from the upper to the lower airways.¹ Bronchiolitis is a common lower respiratory tract infection among young children during the first two years of life. It is typically caused by viral pathogens and is associated with high morbidity, increased hospital admissions, and significant healthcare costs, despite its relatively low mortality.^{2,3} Although the term bronchiolitis implies inflammation of the bronchioles, the diagnosis is made clinically, and the most accurate definition of the condition remains a subject of debate.⁴ There is currently no universally accepted definition of bronchiolitis or a standardized upper age limit. In Europe, wheezing is considered a less essential diagnostic feature in children under two years of age, and several recent studies from Europe and the United States have limited their study populations to children up to 12 months old.²

Approximately 20% of children develop bronchiolitis within their first year of life. In the United States, the incidence has risen from 188 per 1,000 infants in 1996–1997 to 265 per 1,000 infants in 2002–2003.

A Norwegian study reported a mean annual hospitalization rate of 21.7 per 1,000 children under 12 months for RSV bronchiolitis, while a large study from England found an admission rate of 24.2 per 1,000 infants in the same age group.² Bronchiolitis follows a distinct seasonal pattern, with peak incidence during the winter months.² Human respiratory syncytial virus (RSV) is the most common causative agent,⁵ and its seasonal trend is consistent worldwide, with most cases occurring from October to May in the Northern Hemisphere.² Although bronchiolitis is typically a self-limiting disease, hospitalization rates have increased over the past two decades. Approximately 60–70% of hospitalized infants with bronchiolitis^{5,6} require close monitoring and supportive treatment.⁷ Among them, 2–6% require admission to a pediatric intensive care unit (PICU), with 2–3% needing invasive mechanical ventilation.⁸ Globally, bronchiolitis contributes to an estimated 60,000 deaths annually in children under five years of age.⁹

Epidemiological data indicate that prematurity, young age, environmental exposures such as passive smoking and crowded living conditions, and underlying comorbidities—including chronic lung disease, congenital heart disease, immunodeficiency, and neurological disorders—are associated with an increased risk of severe bronchiolitis.^{5,8}

Study Hypotheses:

Certain clinical and demographic factors are

1. significantly associated with the need for PICU admission in children with bronchiolitis.
2. Children admitted to the PICU exhibit more severe clinical features compared with those admitted to the general pediatric ward.

Study design & setting:

The study was designed as retrospective, and carried out at the Jala Children's Hospital Tripoli, Libya. The study was all patients aged less than 2 years admitted with diagnosis of bronchiolitis. Study was conducted from 1st of November 2018 to 31st of March 2019. (CXR), and finally whether admitted in regular usual ward or ICU.

Data Management and Analysis:

The collected data were sorted, coded, and entered into SPSS version 25.0 for analysis. Descriptive statistics were used to summarize patient demographics, clinical characteristics, and outcomes. Inferential statistics, including the chi-square test for categorical variables and the independent t-test for continuous variables, were performed to assess associations between variables. A p-value of <0.05 was considered statistically significant.

Results;

Demographic Characteristics and Medical History:

A total of 90 children with a clinical diagnosis of bronchiolitis admitted to Jala Children's Hospital in Tripoli, Libya, were included in the study. Of these, 54 children (60%) were admitted to the general ward, while 36 children (40%) required admission to the PICU. Regarding age distribution, 53.7% of PICU patients and 55.6% of ward patients were younger than three months. Statistical analysis showed no significant association between age and PICU admission ($p = 0.863$).

The majority of children admitted to the general ward were male (70.4%) compared with 29.6% female, whereas PICU admissions were evenly distributed between males and females (50% each). This difference was not statistically significant ($p = 0.053$). Regarding exposure to passive smoking, 22.2% of PICU patients had a history of passive smoke exposure, compared with 35.2% of ward patients, with no significant association observed ($p = 0.189$).

Feeding type, however, was significantly associated with PICU admission. A larger proportion of children admitted to the general ward were breastfed (77.8%) compared with only 27.8% of PICU patients. Conversely, a higher proportion of PICU patients were formula-fed (72.2%) compared with 22.2% of ward patients ($p = 0.001$).

Regarding mode of delivery, 53.7% of children admitted to the general ward were delivered vaginally, whereas 46.3% of PICU patients were delivered by cesarean section. This difference was not statistically significant ($p = 0.54$). Additionally, the mean birth weight of children admitted to the PICU was slightly higher than that of ward patients (3.23 kg vs. 3.07 kg), but this difference was also not statistically significant ($p = 0.342$) (Table 1).

Table 1: Distribution of demographic characteristic among patients according to word admission VS I.C.U admission (n=90).

Variable		L.C.U admission (n=36)		Ward admission (n=54)		p-value
		N	%	N	%	
Gender	Male	18	50.0	38	70.40	0.051 ¹
	Female	18	50.0	16	29.6	
Age group	Less than 3 months	20	55.6	29	53.7	0.863 ¹
	More than 3 months	16	44.4	25	46.3	
Type of feeding	Breast feeding	10	27.8	42	77.8	0.001 ¹
	Breast feeding	26	72.2	12	22.2	
Type of delivery	Normal delivery	17	47.2	29	53.7	0.547 ¹
	Cesarean section	19	52.8 5	25	46.3	
H/of passive Smoking	Yes	8	22.2	19	35.2	0.189 ¹
	No	28	77.8	35	64.8	
Maturity	Mature	30	83.3	49	90.7	0.293 ²
	Premature	6	16.7	5	9.3	

Birth weight in Kg (mean $\pm$ SD)	3.074 $\pm$ 0.815	$\pm$ 0.713 3.230	0.342 ³
---------------------------------------	----------------------	----------------------	--------------------

The values were expressed as frequency, percentage.1: Chi square test. Fisher exact test 2,3. Independent sample T test. $P < 0.05$ is statistically significant.

CLINICAL PRESENTATION AND CLINICAL COURSE:

Children admitted to the PICU had a higher mean respiratory rate and lower mean oxygen saturation compared with those admitted to the general ward, with both differences reaching statistical significance ($p < 0.001$). The most common symptoms prompting hospitalization were cough, reported in 94.4% of PICU patients and 98.1% of ward patients, and wheezing, reported in 100% of PICU patients and 96.3% of ward patients. There were no significant differences between the groups for either symptom (cough, $p = 0.338$; wheezing, $p = 0.243$).

Regarding steroid therapy, 100% of PICU patients and 94.4% of ward patients received intravenous steroids upon admission; however, this difference was not statistically significant ($p = 0.150$).

TREATMENT AND RADIOLOGICAL FINDINGS:

All patients admitted to the PICU (100%) and the majority of ward patients (94.4%) received inhaled β_2 -agonist therapy, with no significant difference between the groups ($p = 0.150$). Similarly, intravenous antibiotics were administered to all PICU patients (100%) and most ward patients (96.3%), also showing no significant difference ($p = 0.150$).

Regarding chest X-ray (CXR) findings, 72.2% of PICU patients had normal CXRs, while 27.8% showed abnormal findings. Among ward patients, 64.8% had normal CXRs, and 35.2% were abnormal. The difference in CXR findings between the two groups was not statistically significant ($p = 0.693$). X-ray was abnormal when admitted on regular ward. These results revealed that there was not a significant relationship between the two variables ($P = 0.693$).

Table 2: Presentation and clinical course among children with bronchiolitis, admission

clinical course	I.C.U admission (n=36)			Ward admission (n=54)		p-value
	Count		%	Count	%	
Duration of illness (mean $\pm$ SD)	5.00 $\pm$ 3.780			5.16 $\pm$ 4.623		0.511 ²
Cough	Yes	34	94.4 %	53	98.1 %	0.338 ¹
	No	2	5.6 %	1	1.9 %	
Wheeze	Yes	36	100.0 %	52	96.3 %	0.243 ¹
	No	0	0.0 %	2	3.7 %	
Respiratory rate (mean $\pm$ SD)	65.53 $\pm$ 6.784			53.54 $\pm$ 7.750		< 0.001 ²
Heart rate (mean $\pm$ SD)	150.39 $\pm$ 22.501			147.52 $\pm$ 22.343		< 0.553 ²
O2 saturation (mean $\pm$ SD)	86.69 $\pm$ 5.985			93.17 $\pm$ 3.710		< 0.001 ²
Steroid given	Yes	36	100.0 %	49	90.7 %	0.060 ¹
	No	0	0.0 %	5	9.3 %	
Inhaled B2 agonist	Yes	35	97.2 %	54	100.0 %	0.218 ¹
	No	1	2.8 %	0	0.0 %	
Antibiotics	Yes	36	100.0 %	52	96.3 %	0.243 ¹
	No	0	0.0 %	2	3.7 %	
Chest X ray	Normal	31	86.1 %	48	88.9	0.693 ¹
	Abnormal	5	13.9 %	6	11.1 %	

The values were expressed as frequency, percentage. 1:Chi square test.2Independent -sample T test. P < 0.05 is statistically significant.

PREDICTORS OF PICU ADMISSION

Logistic regression analysis was performed to identify factors associated with PICU admission among children with bronchiolitis. Bottle-fed infants were approximately six times more likely to require PICU admission compared with breastfed infants (OR 6.0; 95% CI 1.425–25.307; p = 0.015). Each 1% increase in respiratory rate was associated with a 17% increase in the odds of PICU admission (OR 1.17; 95% CI 1.082–1.285; p < 0.001).

Lower oxygen saturation was also a significant predictor, with decreasing SpO₂ associated with higher odds of PICU admission (OR 0.769; 95% CI 0.652–0.909; p < 0.001).

These results indicate that feeding type, respiratory rate, and oxygen saturation are significant determinants of bronchiolitis severity requiring intensive care

Table 3 : Logistic regression analysis of the factors associated with I.C.U admission to Jala Children's Hospital in Tripoli, Libya

Characteristic	Coefficient B	P-value	OR	%95 CI
Bottle feeding	1.793	.015	6.006	1.425-25.307
Respiratory rate	.165	.000	1.179	1.082-1.285
O2 saturation	-.262	.002	.769	0.652-.0909
Constant	11.013	-	-	

OR = odds ratio; CI = confidence interval

DISCUSSION

Bronchiolitis remains a leading cause of hospitalization among infants worldwide, particularly during the first year of life. In our study, all PICU admissions occurred in infants aged less than one year, highlighting the vulnerability of this age group to severe disease. The overall PICU admission rate of 40% in our cohort underscores the significant morbidity associated with bronchiolitis, despite its generally self-limiting nature.

Our study identified three major predictors of PICU admission: bottle feeding, rapid respiratory rate, and low oxygen saturation. Formula-fed infants were approximately six times more likely to require PICU admission than breastfed infants ($p = 0.015$). This finding is consistent with previous research by Oddy et al., which demonstrated that early cessation of predominant breastfeeding (before 2 months of age) was associated with increased hospital visits for upper respiratory tract infections. These results support the protective role of breastfeeding against severe respiratory infections, potentially due to the immunologic and anti-inflammatory properties of breast milk.

Rapid respiratory rate was also a significant predictor of PICU admission (mean 65.53 ± 6.84 breaths/min; $p < 0.001$). This finding aligns with prior studies indicating that tachypnea on admission is a reliable early marker of disease severity in bronchiolitis. For example, a prospective cohort study of hospitalized children under two years found that an initial respiratory rate of 70 breaths per minute predicted subsequent transfer to the intensive care unit. Clinically, this underscores the importance of careful monitoring of respiratory rate as an early warning sign for deterioration.

Low oxygen saturation on room air was the third significant predictor of PICU admission (mean $86.6 \pm 5.9\%$; $p < 0.001$). Previous studies have suggested a cutoff of $<90\%$ SpO_2 as an indication for higher-level care, which is broadly consistent with our findings. The slightly lower mean saturation in our cohort may reflect the

tertiary referral nature of our hospital, which receives more critically ill patients from surrounding facilities.

Interestingly, other factors traditionally associated with bronchiolitis severity, such as age within the first year, gender, history of passive smoking, birth weight, and chest X-ray findings, were not significantly associated with PICU admission in our study. These findings suggest that clinical parameters at presentation, such as feeding type, respiratory rate, and oxygen saturation, may be more immediately useful in identifying infants at risk of severe disease than some historical or demographic factors.

Our findings have important clinical implications. Early identification of infants at high risk for PICU admission allows for prompt supportive care, careful monitoring, and timely escalation of therapy. Additionally, these results reinforce the promotion of breastfeeding as a potential preventive measure against severe bronchiolitis.

Limitations of this study include its retrospective design, single-center setting, and relatively small sample size, which may limit generalizability. Additionally, viral etiology was not systematically identified, so differences in causative pathogens could not be assessed. Future prospective multicenter studies with larger cohorts and comprehensive viral testing would help validate and expand upon these findings.

In conclusion, our study demonstrates that bottle feeding, increased respiratory rate, and low oxygen saturation are significant predictors of PICU admission in infants with bronchiolitis. These findings highlight the importance of early clinical assessment in guiding the level of care and suggest that standardized protocols for risk stratification could improve outcomes in hospitalized infants.

CONCLUSION AND RECOMMENDATION

In our study, bottle feeding, low oxygen saturation, and rapid respiratory rate were identified as independent predictors of PICU admission in infants with bronchiolitis. These findings highlight the importance of early clinical assessment in identifying infants at risk of severe disease. We recommend that the emergency department at our hospital develop standardized criteria and protocols for ICU admission, incorporating these predictors, to ensure timely and appropriate care for high-risk patients. Additionally, promoting breastfeeding may serve as a preventive measure against severe bronchiolitis.

ACKNOWLEDGEMENTS;

We offer our first and last thanks to Allah who has given us the ability to accomplish this work. We thank people who have played a major role in the success of this work by their feedback and guidance during the preparation of this work. Great thanks to Dr. Abdulbasit Afhayl Alboum For his great help for their assistance with analyses and data presentation.

REFERENCE

1. Naz R, Gul A, Javed U, Urooj A, Amin S, Fatima Z. Etiology of acute viral respiratory infections common in Pakistan: A review. *Rev Med Virol.* 2019;29(2):1-6. doi:10.1002/rmv.2024
2. Øymar K, Skjerven HO, Mikalsen IB. Acute bronchiolitis in infants, a review. *Scand J Trauma Resusc Emerg Med.* 2014;22(1):1-10. doi:10.1186/1757-7241-22-23
3. Shantanam S. 乳鼠心肌提取 HHS Public Access. *Physiol Behav.* 2018;176(1):139-148. doi:10.1136/jim-2018-000708.Predictors
4. Fretzayas A, Moustaki M. Etiology and clinical features of viral bronchiolitis in infancy. *World J Pediatr.* 2017;13(4):293-299. doi:10.1007/s12519-017-0031-8
5. El Basha NR, Marzouk H, Sherif MM, El Kholy AA. Prematurity, a significant predictor for worse outcome in viral bronchiolitis: A comparative study in infancy. *J Egypt Public Health Assoc.* 2019;94(1):1-6. doi:10.1186/s42506-019-0015-8
6. Janahi I, Abdulkayoum A, Almeshwesh F, Alkuwari M, Alhammadi A, Alameri M. Viral aetiology of bronchiolitis in hospitalised children in Qatar. *BMC Infect Dis.* 2017;17(1):1-11. doi:10.1186/s12879-017-2225-z
7. Picone S, Fabiano A, Roma D, Paolillo P. Comparing of two different epidemic seasons of bronchiolitis. *Ital J Pediatr.* 2018;44(1):10-11. doi:10.1186/s13052-018-0454-4
8. Ghazaly M, Nadel S. Characteristics of children admitted to intensive care with acute bronchiolitis. *Eur J Pediatr.* 2018;177(6):913-920. doi:10.1007/s00431-018-3138-6
9. Kenmoe S, Kengne-Nde C, Ebogo-Belobo JT, Mbaga DS, Modiyinji AF, Njouom R. Systematic review and meta-analysis of the prevalence of common respiratory viruses in children < 2 years with bronchiolitis in the preCOVID-19 pandemic era. *PLOS One.* 2020;15(11 November):1-16. doi:10.1371/journal.pone.0242302
10. Oddy WH, Sly PD, De Klerk NH, et al. Breast feeding and respiratory morbidity in infancy: A birth cohort study. *Arch Dis Child.* 2003;88(3):224-228. doi:10.1136/adc.88.3.224
11. Macias G, Fisher ES, Piedra PA, Espinola JA. HHS Public Access. 2016;15(1):77-81. doi:10.1016/j.acap.2014.06.008.Risk
12. Walsh P, Rothenberg SJ, O'Doherty S, Hoey H, Healy R. A validated clinical model to predict the need for admission and length of stay in children with acute bronchiolitis. *Eur J Emerg Med.* 2004; 11:265-72.