

Prevalence of Severe Acute Bronchiolitis in Al-Ramadi Maternity and Children's Teaching Hospital

Bara'a Nouri Abed¹, Mohammed Maher Al-Ani², and Raid M. Al-Ani^{*3}, and Asfar Alshibib⁴

¹ Department of Pediatrics, Al-Ramadi Teaching Hospital for Maternity and Children, Anbar Health Directorate, Ramadi City, Anbar, Iraq.

² Department of Pediatrics, College of Medicine, University of Anbar, Anbar, Iraq.

³ Department of Surgery, Otolaryngology, College of Medicine, University of Anbar, Anbar, Iraq.

⁴ Medical Microbiology, Canadian College of Medical Technologist, Toronto, Canada.

* Corresponding Authors Email: nooribaraa@gmail.com, dr.mohameed.m@uoanbar.edu.iq,
* med.raed.alani2003@uoanbar.edu.iq, asfar1999@gmail.com

ABSTRACT

Background: Acute bronchiolitis is a common respiratory illness in infants and young children with variable clinical severity, sometimes leading to serious complications or death.

Objectives: To evaluate the prevalence, risk factors, and outcomes of severe acute bronchiolitis in children. **Methods:** A cross-sectional study was conducted over six months at Al-Ramadi Maternity and Children Teaching Hospital, involving 511 children aged ≤ 2 years with their first episode of bronchiolitis. Cases were categorized into mild, moderate, or severe. **Results:** Out of the 511 cases, 109 (21.3%) as severe bronchiolitis. The majority were infants aged 1-6 months, with a slight male predominance. Most patients resided in rural areas, and overcrowded households were common. Significant associations (P -value < 0.05) were found between disease severity and factors such as young age, cesarean delivery, lower parental education, overcrowding, use of oil-based heating, and lack of maternal supplementation during pregnancy. Bottle feeding was the most prevalent type, but feeding method and parental smoking showed no significant association (P -value > 0.05) with disease severity. Pneumonia was the most frequent complication (22.5%), followed by apnea (8.8%), and respiratory care unit admission (11.7%). The observed mortality rate 3.1%. **Conclusion:** Acute bronchiolitis remains a significant cause of infant morbidity and mortality. Early identification of risk factors and improved supportive care are essential, especially in resource-limited settings.

Keywords: Bronchiolitis; Acute severe bronchiolitis; Severity, Complications; Risk factors.

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INTRODUCTION

Acute bronchiolitis is the most common acute lower respiratory tract viral infection, caused mostly by respiratory syncytial virus (RSV), and the leading cause of hospitalization and death in children less than two years of age [1]. Bronchiolitis shows a seasonal pattern, with the highest incidence occurring during the winter months, particularly from November to March. Clinically, it typically presents with expiratory breathing difficulty in infants. Other, less specific symptoms may include cough,

tachypnea, chest retractions, hyperinflation, widespread crackles, and wheezing. The clinical course of the disease is often variable and can progress rapidly from mild symptoms to severe respiratory failure. Early diagnosis and prompt management are essential to reduce the risk of complications and mortality in affected infants [2, 3].

RSV is estimated to infect over 60% of children within their first year of life, with nearly all children exposed by the age of two years. Other viruses such as rhinovirus (RV), parainfluenza virus, human metapneumovirus (MPV), influenza virus, and adenovirus have

also been identified as causes, either alone or as co-infections [4, 5]. Despite the availability of multiple clinical guidelines, there remains considerable variability in the diagnosis, monitoring, and treatment of viral bronchiolitis. This highlights the need to standardize diagnostic and therapeutic protocols [6].

Globally, bronchiolitis is diagnosed primarily through clinical history and physical examination. As no virus-specific treatment currently exists, management relies on supportive care aimed at alleviating respiratory and systemic symptoms [1]. In the absence of an RSV vaccine, preventive strategies largely depend on environmental and hygiene measures to reduce transmission [7]. Delay in the diagnosis and timely treatment of acute bronchiolitis can lead to respiratory failure. Due to this serious complication, numerous studies have investigated the severity of the disease globally. However, most of the existing research originates from Western or high-income countries.

This study provides valuable data from Ramadi City, Iraq, where unique socioeconomic and environmental factors, such as indoor air pollution and nutritional status, may influence disease severity patterns. Furthermore, the development of a predictive model for severe bronchiolitis could assist clinicians in early triage, hospitalization decisions, and parental counseling. Therefore, this study aimed to assess the prevalence of severe acute bronchiolitis, identify potential risk factors associated with its development, and evaluate the complications and outcomes in affected children.

METHODS

This cross-sectional study was conducted over a period of six months, from 1st of November 2022 to 30th of April 2023, at the Pediatric Department of Al-Ramadi Maternity and Children Teaching Hospital, Ramadi City, Iraq. Ethical approval for the study was obtained from the Scientific Council of Arab Board of Pediatrics. Informed consent was obtained from the parents or legal guardians of all participating children. All information was anonymized by removing names and replacing them with

identification codes. Data were stored securely on a password-protected laptop and used solely for research purposes, ensuring strict confidentiality. The study was conducted in full accordance with the ethical standards outlined in the Declaration of Helsinki.

Children aged ≤ 24 months presenting with clinical features suggestive of acute bronchiolitis were eligible for inclusion. Diagnosis was made based on the presence of the first episode of wheezing in association with symptoms of a viral upper respiratory infection, such as cough, rhinorrhea, and respiratory distress, including tachypnea, retractions, and auscultatory findings of wheezing or crackles. Children with underlying congenital heart disease, chronic lung conditions such as bronchopulmonary dysplasia, known or suspected immunodeficiency, recurrent wheezing episodes, or evidence of concomitant bacterial pneumonia were excluded.

For each eligible patient, data were collected on demographic variables including age in months, sex, and place of residence (urban or rural), as well as clinical findings such as respiratory rate, oxygen saturation, chest retractions, feeding difficulty, cyanosis, and auscultation findings. Additional data were gathered regarding need for pediatric intensive care unit (PICU), use of ventilatory support, complications such as pneumonia, apnea or respiratory failure, and patient outcomes, including duration of hospital stay, discharge status, and mortality. The age of the participants was divided into 4 groups: < 1 month, 1-6 months, > 6 months-one year, and > 1 year-2 years.

The severity of bronchiolitis was graded as mild, moderate, or severe based on a combination of clinical and oxygenation parameters: mild cases exhibited normal oxygen saturation ($\geq 94\%$) and no significant distress, moderate cases had oxygen saturation between 90–93% and moderate retractions, while severe cases had saturation $< 90\%$, marked respiratory distress, apnea, or required PICU admission.

Management followed standardized hospital protocols, which included supportive care such as oxygen therapy for hypoxia ($SpO_2 < 92\%$), nasal suctioning, adequate hydration either orally or intravenously, and monitoring of

respiratory status. Bronchodilators and hypertonic saline nebulization were used selectively based on physician judgment. Antibiotics were reserved for cases with suspected secondary bacterial infection. Severe cases requiring intensive monitoring were admitted to the PICU and managed accordingly, with escalation to ventilatory support when indicated.

The required sample size was originally calculated using the formula for single-proportion estimation at 95% confidence level, assuming an expected prevalence of severe bronchiolitis at 30% from a previous study and a margin of error of 7%, resulting in a minimum of 165 patients. However, to enhance the study's statistical power and improve the precision of prevalence estimates, a total of 511 patients were enrolled during the study period. Increasing the sample size offers several benefits, including tighter confidence intervals, greater reliability of subgroup analysis (such as by sex, age group, or residence), and increased ability to detect associations between potential risk factors and severe outcomes.

Statistical analysis

All data were entered and analyzed using IBM SPSS (Statistical Package for the Social Sciences) version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as means with standard deviations. Chi-square or Fisher's exact tests were used to assess associations between categorical variables, and independent *t*-tests or Mann–Whitney U tests were applied for continuous data, with a P-value of less than 0.05 considered statistically significant.

RESULTS

511 patients included in the study, 109(21.3%) as severe bronchiolitis. The study patients' age was ranging from 7 days to 23 months with a mean of 6.48 ± 6.4 months. Severe bronchiolitis was significantly (P -value < 0.05) more common among younger children, particularly those under one month of age (39.8%), female sex (27.4%), children with a birth order of fourth or higher (34.4%), and those delivered by cesarean section (25.7%) as shown in **Table 1**.

Severe bronchiolitis was significantly more common among children whose fathers and mothers were illiterate [18(45%), P -value=0.001; and 30(30.6%), P -value=0.001, respectively], those whose fathers had private jobs [86(29.8%), P -value=0.004], those living in crowded households [72(24.6%), P -value=0.038], those using oil-based heating in the home [55(36.2%), P -value=0.001], and those whose mothers not received supplements during pregnancy [60(40.2%), P -value=0.005] as illustrated in **Table 2**. No significant (P -value >0.05) association were found between the severity of disease and clinical variables as indicated in **Table 3**. The most common complication observed was pneumonia ($n=115$, 22.5%). Additionally, 16 patients (3.1%) died (**Table 4**).

Logistic regression analysis was performed using severe bronchiolitis as the dependent variable and the variables that showed significant associations in the bivariate analysis as independent predictors. Three factors emerged as significant independent risk factors: younger age (less than one month; OR=1.217), female gender (OR=5.16), and use of oil-based heating (OR=4.741), as shown in **Table 5**.

Table (1): Association between bronchiolitis severity and general characteristics in 511 patients.

General Characteristics	Severity of bronchiolitis		P-value
	Severe n(%) 109(21.3)	Non-severe n(%) 402(78.7)	
Age in months			
< 1	41(39.8)	62(60.2)	0.001
1-6	44(20.5)	171(79.5)	
6-12	24(27.6)	63(72.4)	
> 12	0(0)	106(100.0)	

General Characteristics	Severity of bronchiolitis		P-value
	Severe n(%) 109(21.3)	Non-severe n(%) 402(78.7)	
Sex			
Male	50(16.9)	246(83.1)	0.004
Female	59(27.4)	156(72.6)	
Residence			
Urban	44(19.7)	179(80.3)	0.437
Rural	65(22.6)	223(77.4)	
Baby's rank in the family			
1 st	2(2.2)	89(97.8)	0.001
2 nd or 3 rd	44(18.6)	193(81.4)	
4 th or more	63(34.4)	120(65.6)	
Feeding history			
Breast	21(27.6)	55(72.4)	0.483
Bottle	48(20.1)	191(79.9)	
Mixed	38(20.9)	144(79.1)	
Bottle + added food	2(14.3)	12(85.7)	
Gestational age at delivery			
Term	91(20.2)	360(79.8)	0.08
Preterm	18(30.0)	42(70.0)	
Mode of delivery			
Normal vaginal delivery	42(16.8)	208(83.2)	0.014
Cesarean section	67(25.7)	194(74.3)	
Vaccination			
Regular	83(20.3)	326(79.7)	0.251
Irregular	26(25.5)	76(74.5)	

Table 2: Association between bronchiolitis severity with parental and environmental characteristics in 511 patients.

Variable	Severity of bronchiolitis		P-value
	Severe n(%) 109 (21.3)	Non-severe n(%) 402(78.7)	
Father education			
Illiterate	18(45.0)	22(55.0)	0.001
Primary	46(24.3)	143(75.7)	
Secondary	36(17.8)	166(82.2)	
Higher education	9(11.3)	71(88.8)	
Father occupation			
Employee	23(10.5)	197(89.5)	0.001
Private work	86(29.8)	203(70.2)	
Student	0(0)	2(100.0)	
Mother education			
Illiterate	30(30.6)	68(69.4)	0.001
Primary	57(25.6)	166(74.4)	
Secondary	15(11.9)	111(88.1)	
Higher education	7(10.9)	57(89.1)	
Mother occupation			
Housewife	98(22.6)	335(77.4)	0.222
Employee	7(13.0)	47(87.0)	
Student	4(16.7)	20(83.3)	
Crowding family			
Yes	72(24.6)	221(75.4)	0.038
No	37(17.0)	181(83.0)	

Variable	Severity of bronchiolitis		P-value
	Severe n(%) 109 (21.3)	Non-severe n(%) 402(78.7)	
Passive smoking			
Yes	48(22.5)	165(77.5)	0.574
No	61(20.5)	237(79.5)	
Type of heating			
Electric	54(15.0)	305(85.0)	0.001
Oil heating	55(36.2)	97(63.8)	
Supplementation during pregnancy			
Yes	89(24.6)	273(75.4)	0.005
No	60(40.2)	89(59.8)	

Table 3: Association between bronchiolitis severity and clinical information in 511 patients. URTI: Upper respiratory tract infection.

Variable	Severity of bronchiolitis		P-value
	Severe n(%) 109(21.3)	Non-severe n(%) 402(78.7)	
History of neonatal intensive care unit admission			
Yes	28(24.3)	87(75.7)	0.369
No	81(20.5)	315(79.5)	
Baby supplement last six months			
Yes	43(20.6)	166(79.4)	0.728
No	66(21.9)	236(78.1)	
History of atopy in family			
Yes	21(24.7)	64(75.3)	0.405
No	88(20.7)	338(79.3)	
History of contact with children suffering from URTI			
Yes	86(22.2)	302(77.8)	0.413
No	23(18.7)	100(81.3)	

Table 4: Distribution of 511 patients according to the outcome. PICU: Pediatric intensive care unit.

Variable	Frequency	Percentage
Complication		
No complication	306	59.9
Pneumonia	115	22.5
Lung collapse	56	11.0
Pneumonia + lung collapse	13	2.5
Dehydration	13	2.5
Pneumothorax	8	1.6
Apnea	45	8.8
Need PICU	60	11.7
Fate		
Discharged well	495	96.9
Died	16	3.1

Table 5: Logistic regression analysis for the association of various risk factors with prevalence of severe bronchiolitis.

Variables	Odd's ratio	P-value
Age (< 1month)	1.217	0.001
Female	5.16	0.001
Oil heating	4.741	0.001

DISCUSSION

Acute viral bronchiolitis, most commonly caused by RSV, primarily affects the lower respiratory tract and represents a frequent cause of hospitalization in infants and young children. It accounts for approximately 13-17% of admissions in children aged ≤ 24 months. As with other viral infections, supportive care remains the cornerstone of treatment. This includes maintaining adequate hydration and electrolyte balance, nasal suctioning, and oxygen therapy when required. Nonetheless, additional therapeutic options such as corticosteroids, inhaled bronchodilators, and nebulized epinephrine are occasionally used in clinical practice [8]. In the current study, severe acute bronchiolitis was observed in approximately one-fifth of the enrolled cases. Additionally, several factors may be associated with the severity of the disease, including, but not limited to, young age, female sex, cesarean delivery, low parental education, overcrowded household conditions, and the use of oil-based heating. Infants under 12 months, particularly those aged 2-6 months, are the most commonly affected by acute bronchiolitis due to immature immunity, narrow airways, and poor secretion clearance. The decline in maternal antibodies also increases their vulnerability to infections like RSV. In line with previous studies [3, 9-11], our findings showed higher frequency and severity in infants aged 1-6 months, emphasizing the need for early recognition and supportive care in this high-risk group.

Male infants are generally more affected by acute bronchiolitis, likely due to narrower airways and early hormonal and immune differences. Large-scale studies have consistently shown higher rates of emergency visits and hospital admissions among boys [12-15]. In our study, although males were slightly more affected, female sex was significantly associated with greater disease severity. The

reason for this remains unclear. These findings underscore the importance of assessing severity in both sexes and not relying solely on typical prevalence trends. In this study, a higher number of bronchiolitis cases were observed among infants from rural areas compared to urban ones. However, residence showed no significant association with disease severity. This may reflect improved access to healthcare services and transportation in rural regions of our society, allowing for earlier medical intervention and potentially limiting the progression to severe illness despite the presence of environmental risk factors.

This study found a significant association between lower parental education and both the prevalence and severity of acute bronchiolitis. Most affected infants had parents with only primary or secondary education, which may reflect limited awareness, delayed care-seeking, and inadequate prevention practices. Similar studies support this link [16, 17]. The findings emphasize the need for targeted health education among less-educated parents in high-risk communities.

The present study found a significant association between household overcrowding and both the prevalence and severity of acute bronchiolitis. Infants in crowded homes had higher disease rates and more severe illness. Previous studies from Iraq, similarly linked poor living conditions to bronchiolitis severity [17, 18]. International studies also show that overcrowding triples the risk of hospitalization for respiratory infections [16, 19]. These findings highlight overcrowding as a key risk factor, likely due to increased exposure and poor ventilation, emphasizing the need for targeted public health measures. In the current study, most infants with acute bronchiolitis had received routine vaccinations, yet no significant link was found between vaccination status and

disease severity. This aligns with evidence that standard immunizations (e.g., pneumococcus, *H. influenzae* type b) help prevent bacterial complications but may not reduce viral bronchiolitis severity, which is mainly caused by RSV [20]. The absence of a widely available RSV vaccine or monoclonal antibody during the study period likely contributed to this finding [21]. Still, maintaining high vaccination coverage remains crucial for preventing secondary infections and supporting overall child health.

In Iraq, infant formula has been used since 1970. Its use has increased, especially in recent times, due to several reasons including the rise in cesarean section rates, wars, displacement, and migration [22]. Also, in this study, bottle feeding was the most common feeding method, yet it showed no significant association with bronchiolitis severity. This contrasts with previous research suggesting exclusive breastfeeding may protect against respiratory infections due to immune factors like secretory IgA and cytokines [23]. The lack of significant association in our study may be due to multiple interacting factors, including environmental exposures, viral load, host immune responses, and variations in maternal and infant health behaviors. These results highlight the need for larger, more comprehensive studies to better understand the impact of feeding practices on the development and clinical course of bronchiolitis. Moreover, raising awareness among women about the benefits of breastfeeding and the potential drawbacks of bottle feeding is crucial for promoting the health and well-being of infants.

In the current study, no significant association was found between parental smoking and the prevalence or severity of acute bronchiolitis in affected infants. This contrasts with findings from numerous national or international studies, which have consistently identified passive exposure to tobacco smoke, particularly maternal smoking, as a significant risk factor for both the development and increased severity of bronchiolitis [18, 24]. Tobacco smoke impairs mucociliary function, weakens local immune defenses, and promotes airway inflammation, thereby increasing vulnerability to severe respiratory infections.

However, the lack of association in the present study may be explained, at least in part, by the relatively low prevalence of maternal smoking in Iraq due to prevailing cultural norms and social expectations. Additionally, underreporting of smoking behavior, especially among mothers, as well as variations in exposure levels and household ventilation, may have contributed to the absence of a statistically significant link. Nevertheless, promoting smoke-free environments remains an important preventive measure for reducing the overall burden of respiratory illness in young children.

Our study demonstrated a highly significant association between the use of oil-based heating and both the prevalence and severity of acute bronchiolitis in infants, compared to households using electric heating. Oil heaters, especially in poorly ventilated indoor environments, can release a variety of harmful pollutants, including nitrogen dioxide, particulate matter, and volatile organic compounds. Airborne irritants impair respiratory function and heighten infants' susceptibility to bronchiolitis due to their narrow airways and developing lungs. This study supports prior research showing indoor air pollution from fuel combustion as a key risk factor for lower respiratory infections in children [25]. Promoting cleaner heating methods is vital to reduce bronchiolitis risk.

This study found that lack of maternal supplementation during pregnancy was significantly associated with increased prevalence and severity of acute bronchiolitis. Deficiencies in key nutrients like vitamins A, D, C, iron, and folic acid may impair fetal immune development and postnatal respiratory health, increasing susceptibility to infections. These findings align with evidence linking poor prenatal nutrition to more severe respiratory illnesses in infancy [26], underscoring the importance of antenatal supplementation programs.

Pneumonia was the most common complication in this study, affecting 22.5% of patients, consistent with prior reports of bacterial pneumonia in bronchiolitis [27]. Apnea occurred in 8.8%, reflecting known risks in younger infants [28], and 11.7% of those under seven months required PICU admission

[5]. The mortality rate was 3.1%, higher than in many studies [29, 30], possibly due to late referrals, comorbidities, or limited access to critical care. These findings highlight the importance of early recognition and intensive management in high-risk cases. Acute bronchiolitis has a significant negative impact on health system in Iraq and other Middle East countries, with seasonal peaks in winter months due to RSV, leading to high rate of admissions to hospitals in these months. In our country, this disease is one of the main reasons for lower respiratory tract infections in the first two years of life, often consuming a lot of health services both in the emergency units and inpatient admissions during peak season. The scenario of high acute bronchiolitis prevalence is the same across all Middle East countries due to the following possible factors: overcrowding, shortage of preventive measures, and differences in healthcare resources, resulting in a high rate of morbidity. This specific regional burden is further aggravated by the absence of immunization programs against RSV as well as of inadequate diagnostic tools, necessitating the improvement in surveillance and preventive measures.

This study has several limitations. It was conducted at a single center, limiting generalizability. The cross-sectional design prevents causal inferences. Severity classification relied on clinical judgment and hospital records, potentially introducing bias. Factors such as viral subtype, co-infections, and detailed nutritional status were not evaluated. Socioeconomic data, including parental education and smoking status, may be affected by recall bias. Nonetheless, the study offers valuable insights into acute bronchiolitis in routine clinical practice.

CONCLUSION

Acute bronchiolitis remains a significant cause of morbidity and hospitalization among infants, with complications such as pneumonia, apnea, and the need for respiratory support being relatively common. While factors like young age, overcrowded living conditions, lower parental education, and use of oil-based heating were significantly associated with

disease severity, others, such as feeding type and parental smoking, showed no clear impact in this cohort. The observed mortality rate, notably higher than in many international reports, highlights the need for early identification of high-risk cases and optimized supportive care. These findings underscore the importance of improving public health education, environmental conditions, and healthcare accessibility to reduce the burden and complications of bronchiolitis in vulnerable pediatric populations.

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Ethical approval

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Statement of permission and conflict of interests

The authors declare no competing interests

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