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RISK FACTORS ASSOCIATED WITH PROLONGED LENGTH OF STAY IN CHILDREN HOSPITALIZED FOR ACUTE BRONCHIOLITIS

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ABSTRACT

Acute bronchiolitis is the most common respiratory disease in infants and young children. 1-3% of children with bronchiolitis require hospitalization, particularly during the winter months. A quarter of patients admitted for acute bronchiolitis may undergo prolonged hospital length of stay (LOS). Because prolonged LOS is directly associated with treatment costs, and because it puts the child at greater risk of developing complications such as hospital-acquired infections, there is a need to identify other risk factors associated with prolonged hospital LOS for acute bronchiolitis (such as parental smoking and a family history of atopy). This will allow for prevention, where possible, and to improve provided healthcare. We conducted a prospective cohort study of 76 children hospitalized for acute bronchiolitis in Lattakia University Hospital. **Objective**: Main objective: To identify risk factors associated with prolonged hospital length of stay in children admitted with acute bronchiolitis at Lattakia University Hospital. **Study method**: Design: Analytic Cohort Study (Prospective) - Sample: 76 children admitted to the pediatric department with acute bronchiolitis, aged two years or younger, excluding those with chronic diseases such as congenital heart defects, bronchopulmonary dysplasia, and multiple hospitalizations.- Statistical Analysis: the following statistics were used:

1- Descriptive Statistics: Frequencies and percentages to represent qualitative variables, measures of central tendency and dispersion to represent quantitative variables.

2- Inferential Statistics: Chi-square or Fisher's exact test to study relationships between qualitative variables. Independent Student's t test to compare mean differences between two independent groups.

All variables were tested using univariate regression. The variables with statistical significance were entered into the Multivariate analysis equation, the relative risk (RR) was measured, confidence intervals were found, and values were considered starting from 2 and above. The results were considered statistically significant with a p-value of 5%. The IBM SPSS statistics (V25) program was used to calculate the statistical coefficients and analyze the results. **Results**: The average length of stay was 4.63±2.5 days, with a percentage of 31.6%. 64.5% of the children were males, with male-to-female ratio 1:1.8. The mean age was 6.41±5.8 months, and the mean birth weight was 2846.05±377.1 g. Prematurity represented 5.3% of the study sample, and none of the above variables were associated with LOS (p=0.4, p=0.8, p=0.6, p=0.1), respectively. 44.7% of the infants were exclusively breastfed, and the mean consultation time was 5.18±3.9 days. Parental smoking was present in 44.7% of the study sample. The above variables did not constitute statistically significant differences (p=0.2, p=0.9, p=0.8), respectively. The mean oxygen saturation was 95.55±4.2. Supplemental oxygen and respiratory distress score at admission were significant risk factors for prolonged hospital LOS in both the univariate model (p=0.01) and the multivariate model (p=0.0001, p=0.002), respectively. 21.1% of the infants had a family history of atopy, and deep suctioning was performed in 59.2% of cases, with a statistically significant association with prolonged LOS (p=0.04, p=0.001) in both the univariate model and the multivariate model (p=0.04, p=0.0001). **Conclusion:** There are a number of clinical parameters that can be identified at admission and are associated with prolonged hospital length of stay for acute bronchiolitis: initial oxygen saturation, supplemental oxygen, and respiratory distress at admission, in addition to a family history of atopy. Deep suctioning is associated with longer length of stay. Further studies are needed to clarify the relationship between various variables and hospital length of stay.

KEYWORDS: Bronchiolitis, length of stay, risk factors, breastfeeding, family history of atopy, deep suctioning.

INTRODUCTION
Acute bronchiolitis is widely defined as a clinical syndrome of respiratory distress occurring in children under the age of two. It is characterized by upper respiratory symptoms (such as a runny nose) followed by a lower respiratory infection with inflammation, leading to wheezing and/or crackles. It might be accompanied with ecough, tachypnea, respiratory distress, hypoxia Irritability, poor nutrition, and vomiting.[1,2]

In France, acute bronchiolitis affects around 480,000 children under the age of two, with the cost of their first hospitalization reaching 5,671 euros Maugendre et al, Authorea 2022.[3]

Risk factors for severe or complex acute bronchiolitis include prematurity (gestational age ≤ 36 weeks), low birth weight (≤ 2500 grams), age less than 12 weeks, chronic lung diseases—particularly bronchopulmonary dysplasia (also known as chronic lung disease)—anatomical abnormalities in the airways, congenital heart diseases with significant hemodynamic impact, immunodeficiency, neurological diseases, and environmental factors such as parental smoking, and air pollution.[4]

Several factors have been identified as associated with the length of hospitalization for this illness in various countries around the world. Prolonged hospitalization is directly linked to treatment costs and also increases the risk of developing complications such as acquired hospital infections. Therefore, there is a need to determine the risk factors that associated with the duration of hospitalization for acute bronchiolitis (such as parental smoking, family history of asthma, etc.), which could provide opportunities for better management and prevention.

We aimed to determine the risk factors that associated with prolonged length of stay in children hospitalized for acute bronchiolitis.

METHODS AND PATIENTS
Study design and population
We conduct an analytical prospective Cohort Study. This study included all children admitted to the Pediatric Department at lattakia University Hospital with a complaint of acute bronchiolitis over a period of one-year .the inclusion Criteria comprised:

Children admitted to the Pediatric Department with a diagnosis of acute bronchiolitis, aged two years or younger, during the study period. The exclusion Criteria: Children with chronic diseases such as congenital heart defects and bronchopulmonary dysplasia and children who had Multiple hospitalizations.

Data Collection
The following variables were obtained, Age (chronological age), Gender, Birth weight (<2500g or ≥2500g), History of prematurity (<37 weeks gestation), Parental smoking, Family history of atopy, Type of feeding during the first 6 months, Duration from the onset of respiratory symptoms to hospital admission (days), Initial oxygen saturation level at admission, Degree of respiratory severity, Use of deep suctioning of secretions (nasopharyngeal suctioning).

Statistical Analysis
Descriptive Statistics : Frequencies and percentages for categorical variables.
Measures of central tendency and measures of dispersion for quantitative variables.
Inferential Statistics: Chi-square test or Fisher's exact test to examine relationships between categorical variables.
Independent Student's t-test to compare mean differences between two independent groups, Univariate regression analysis for all variables.

Variables with statistically significant values were included in a multivariate analysis model
- Relative Risk (RR) was calculated, along with confidence intervals
- Values with RR ≥ 2 and statistically significant results (p-value < 0.05) were considered meaningful and statistically significant.

SPSS software (version 25) was used to perform the statistical analyses and interpret the results.

Ethical Considerations
The study protocol was reviewed and approved by the ethics committee at the Faculty of Medicine – Latakia University, ensuring compliance with ethical standards for research involving human subjects. Informed consent was obtained from all participants prior to data collection, with assurances provided regarding confidentiality and the voluntary nature of participation.

RESULTS
The study sample included 76 children admitted to the Pediatric Department at lattakia University Hospital during the period from September 2023 to October 2024, all presenting with acute bronchitis and meeting the inclusion criteria of the study. The aim of the research was to identify risk factors associated with prolonged hospital stay in these infants. The percentage of males in the sample was 64.5%, with a male-to-female ratio of approximately 1:1.8. The children's ages ranged from 15 days to 24 months, with a mean age of 6.41 ± 5.8 months. Birth weights ranged from 1900 to 4200 grams, with a mean of 2846.05 ± 377.1 grams. The duration of respiratory symptoms before hospital admission ranged from 1 to 10 days, with a mean of 5.18 ± 3.9 days. Oxygen saturation levels ranged from 83% to 99%, with a mean of 95.55 ± 4.2%. The average length of hospital stay was 4.63 ± 2.5 days. Five children (6.58% of the sample) developed hospital-acquired pneumonia during their hospitalization.

The proportion of prematurity was 5.3% of the studied cases. 10.5% of the studied cases had a birth weight of less than 2500 grams.

We noticed that 44.7% of the studied cases involved children with breastfeeding.

We observe that 21.1% of the studied cases had a family history of atopy.

44.7% of the sample of the research had parents who are smokers.

There is no statistically significant difference between the two research groups concerning gender, age, gestational age, birth weight, type of feeding, parental smoking and duration of respiratory symptoms until admission.

Table 1: The distribution of the sample of 76 children according to the presence of family medical history of atopy based on the length of hospitalization.

Family history of atopy	Sample of the research		P- value
	Hospitalization more than 5 days	Hospitalization less than 5 days	
yes	8(33.3%)	8(15.4%)	0.04
No	16(66.7%)	44(84.6%)	

table (1)indicate statistically significant differences between the two research groups regarding the presence of family history of atopy.

Table 2: Shows the distribution of the sample of 76 children according to oxygen needs based on the length of hospitalization.

Need to oxygen	Sample of the research		P- value
	Hospitalization more than 5 days	Hospitalization less than 5 days	
Yes	5(20.8%)	4(7.7%)	0.01
No	19(79.2%)	48(92.3%)	
Mean ± SD	93.50±5.7	96.50±2.9	0.003

Table(2): Showed that there were statistically significant differences between the two research groups regarding the need for oxygen. Specifically, 20.8% of cases stay longer than five days and required oxygen, compared to 7.7% in the group without need for oxygen therapy.

Table 3: The distribution of the sample of 76 children according to the degree of the respiratory distress based on the length of hospitalization.

Degree of respiratory distress	The sample of research		P- value
	Hospitalizations more than 5days	Hospitalizations less than 5days	
Mild	6(25%)	29(55.8%)	0.01
Moderete	12(50%)	18(34.6%)	
Severe	6(25%)	5(9.6%)	

table (3)showed that there were statistically significant differences between the two research groups concerning the degree of respiratory distres.

Table 4: Risk Factors Associated with Length of hospitalizations in Children Admitted with Acute Bronchiolitis.

Risk factors	RR b [CI95%]	RR a [CI95%]	p-value
Need to oxygen	4.5[1.1-8.4]	3.1[1.4-4.3]	0.0001
Deep secretion suction	4.8[1.4-10.6]	3.9[2.2-11.2]	0.0001
Degree of respiratory Distress	3.1[1.7-9.4]	2.7[1.7-9.4]	0.002
Family history of atopy	2.6[0.8-7.8]	1.9[0.9-4.8]	0.04

Table 4 showed the variables that were statistically significant were included in the multivariate analysis. We found that the need for oxygen therapy, the respiratory severity distress at admission, the presence of family history of atopy, and the use of deep suctioning were all risk factors for prolonged hospitalization in children admitted with acute bronchiolitis.

DISCUSSION

This study included 76 children who met the inclusion criteria. The average duration of hospital stay was 4.63 ± 2.5 days. The percentage of children who required a prolonged hospital stay was 31.6%. The study found that there are clinical parameters that can be identified at admission and are associated with prolonged hospitalization in children with acute bronchiolitis. These include initial oxygen saturation, oxygen requirement, the severity of respiratory distress at admission, as well as a family history of allergies and the implementation of deep suctioning of nasal pharyngeal secretions.

The results of the current study are in agreement with a study conducted by Maugendre et al in France in 2022, which found that severe clinical condition at admission and the need for oxygen were significantly associated with prolonged hospitalization for acute bronchiolitis in a multiple regression model.[5] Initial oxygen saturation and disease severity at admission were predictors of longer hospitalization for acute bronchiolitis in this study which is similar to the findings of Martinez et al in Colombia and Gonzalez et al in Spain. Additionally, the need for oxygen support was reported in the study by Ekoube et al in Cameroon.[6,7]

Maugendre et al did not find a relationship between the presence of atopic family history and the duration of hospitalization for acute bronchiolitis, and they attributed the low percentages due to the lack of recording in medical reports. Maugendre et al.[5]

A study by Trefny et al conducted in Switzerland found that when there was a family history of atopy in infants with acute bronchiolitis, the hospitalization period was longer. The same was observed in cases with a high history of asthma in the study by Debnath et al in Bangladesh. This is similar to the findings of the current study.[8]

The percentage of males in the current study was 64.5% of the sample. There was no statistically significant difference between genders regarding the duration of hospitalization and the same according to the age and birth weight. This is consistent with previous studies such as Martinez et al. in Colombia concerning gender and birth weight, as well as Shay et al. and Weisgerber et al. in the United States, and Acar et al. in Turkey regarding age and gender.[9,10] In Spain, low birth weight and age less than one month were factors associated with the length of hospitalization in children with acute bronchiolitis. The difference in demographic results may be due to differences in racial and ethnic variations.[11] Maugendre et al. did not find any correlation between prematurity and the length of hospitalization in their study, this was explained by insufficient spread.[5] Conversely, prematurity was a predictive factor for longer hospitalization duration in children with acute bronchiolitis in the following studies: Martinez et al. in Colombia, Moler et al. in the United States, and Vereen

et al. in the United States.[12] The proportion of prematurity in the current study was 5.3% of the sample and were from the non-prolonged hospitalization group. This might explained the in significant statistical value between prematurity and the length of hospitalization. The average time from the appearance of respiratory symptoms to hospital admission in the current study is 5.18±3.9 days. This is similar to the findings of Debnath et al. in Bangladesh (5.47±1.93 days) and Schroeder et al. in the United States (4 days).[13,14] The exposure to smoking accounted for 44.7% of the current study sample, with no statistically significant relationship with the duration of hospitalization. This was reported by Acar et al and Selen et al in Turkey, and Gonzalez et al in Spain.[15,16] Exposure to smoking is considered a risk factor for hospitalization due to acute bronchiolitis, although it was not associated with longer hospitalization duration in the Fernandez et al.[17]

The proportion of breastfeeding was 44.7% in the current study sample. No relationship was found between the type of feeding in the first six months of life with the duration of hospitalization, which is consistent with the results of studies by Martinez et al. Similarly, a previous study conducted by Vereen et al. in the United States found no correlation between breastfeeding and the length of hospitalization in children with acute viral respiratory infections. Additionally, the study by Acar et al. in Turkey, conducted on newborns with lower respiratory tract infections, also showed no association.

The parental feeding pattern in the current study sample shows that the highest percentage (48.1%) is in the hospitalization group of ≤ 5 days. However, no statistically significant differences were found.

These results may indicate the positive role of breast milk in reducing the severity of the illness. Parental feeding helps enhance the immune response against inflammation caused by the RSV virus in the airway epithelium. It has been shown that decreased neutrophil infiltration in the airways of breastfed children reduces disease severity compared to formula feeding. Additionally, breast milk increases interferon-alpha levels in RSV-infected individuals and decreases the concentration of immune mediators such as chemokines and IL-8 in the airway.[18]

The percentage of deep secretion suctioning (nasopharyngeal suction) in the current study was 59.2%, with a statistically significant relationship with the length of hospitalization. This finding was also mentioned in the studiesof Mussam et al. and Weisgerber et al. in the United States. Mussam et al found that performing deep secretion suctioning within the first 24 hours after hospitalization was associated with a longer duration of stay. They explained this result by the way that deep suctioning of secretions is linked to increased edema and inflammatory response in the airways.[19,20] The role of secretion suctioning in the course of acute bronchiolitis

remains unclear. Additionally, recent recommendations advise against the routine use of deep secretion suctioning in infants with acute bronchiolitis.[20]

This study identified a set of clinical variables that can be associated with prolonged hospitalization in cases of acute bronchiolitis. These include initial oxygen saturation, need for oxygen therapy, and the degree of respiratory distress at admission, as well as a family history of atopy. Deep suctioning of secretions from the nasopharynx is also linked to the length of hospitalization. However, factors such as gender, age, birth weight, breastfeeding history, type of feeding during the first six months and exposure to cigarette smoke showed no significant association.

Limitation of this study: The small sample size limited the ability to experience some important variables, such as the presence of congenital heart disease. Additionally, it was not possible to identify the causative pathogen and examine its correlation with the study outcomes.

This study recommend conducting an accurate assessment at admission to identify factors that may predict prolonged hospitalization for acute bronchiolitis. Avoid routine deep suction of secretions in children with acute bronchiolitis; instead, perform gentle suction only by skilled individuals. Encourage parental breastfeeding as a protective factor against inflammatory diseases. Further studies were needed to evaluate the relationship between various variables and the length of hospital stay.

DECLARATIONS
Ethical approval and consent to participate: Ethical approval to study was obtained from the Scientific Research Ethics Committee at Latakia University in accordance with the Declaration of Helsinki.

Consent for publication: Not applicable.

Availability of Data and Materials: All the data generated or analyzed during this study are included in this published article. The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Author Contribution: Aya Al kousa collected the data, checked the quality of the data collection, analyzed and interpreted the data, designed and coordinated the study, undertook and checked the quality assessment, produced the first draft of the manuscript, wrote and edited the manuscript and approved the final manuscript before submission. Souaad Sakkour and Intesar naser were the supervisor of the project; undertook and checked to the quality assessment, checked the quality of the collected data; analyzed and interpreted the data; checked the quality assessment; edited the manuscript and approved the final manuscript before submission.

REFERENCES
1. Erin Nicholson, MD, MS Alan Schroeder, MD Pedro A Piedra, MD Joshua Nagler, MD, MHPEd Diane Blake, MD, Bronchiolitis in infants and children: Clinical features and diagnosis, UpToDate, 2024.
2. Matthew P. Kronmanet al, Infectious Disease, CURRENT Diagnosis & Treatment Pediatrics TWENTY-FOURTH EDITION.
3. A.Maugendre, C. M´edrinal, T.Bonnevie, P.Le Roux, G.Prieur, and Y.Combr, Factors associated with length to recover adequate nutrition and length of stay in children hospitalized for bronchiolitis: a retrospective study, February 19, 2022.
4. Corneli, Howard & Zorc, Joseph & Holubkov, Richard & Bregstein, Joan & Brown, Kathleen & Mahajan, Prashant & Kuppermann, Nathan. Bronchiolitis Clinical Characteristics Associated With Hospitalization and Length of Stay. Pediatric emergency care., 2012; 28: 99-103. 10.1097/PEC.0b013e3182440b9b.
5. Eposse Ekoube, C., Heles Nsang, E., Épée, P. et al. Predictors of prolonged length of hospital stay and in-hospital mortality in patients aged 1–24 months with acute bronchiolitis in Douala, Cameroon. BMC Pediatr, 2024; 24: 150. https://doi.org/10.1186/s12887-024-04653-x
6. Unger S, Cunningham S. Effect of oxygen supplementation on length of stay for infants hospitalized with acute viral bronchiolitis. Pediatrics, Mar. 2008; 121(3): 470-5. doi: 10.1542/peds.2007-1135. PMID: 18310194.
7. Flores-Gonzalez J, Serrano-Moyano B, Lechuga-Sancho A, et alO-016 Breastfeeding As A Protector Factor For Acute Bronchiolitis Archives of Disease in Childhood, 2014; 99: A28.
8. Trefny P, Stricker T, Baerlocher C, Sennhauser FH. Family history of atopy and clinical course of RSV infection in ambulatory and hospitalized infants. Pediatr Pulmonol, Oct. 2000; 30(4): 302-6. doi: 10.1002/1099-0496(200010)30:4<302::aid-ppul5>3.0.co;2-r. PMID: 11015130.
9. Besnili Acar D, Avsar H, Bulbul A. Evaluation of Etiological Causes and Factors Affect Length of Hospitalization in Neonates Hospitalized with Lower Respiratory Tract Infection. Med Bull Sisli Etfal Hosp, 2024; 58(1): 97–101.
10. Weisgerber MC, Lye PS, Li SH, Bakalarski D, Gedeit R, Simpson P, Gorelick MH. Factors predicting prolonged hospital stay for infants with bronchiolitis. J Hosp Med., May 2011; 6(5): 264-70. doi: 10.1002/jhm.903. PMID: 21661099.
11. Ramos-Fernández JM, Pedrero-Segura E, Gutiérrez-Bedmar M, Delgado-Martín B, Cordón-Martínez AM, Moreno-Pérez D, Urda-Cardona A. Epidemiología de los ingresos por bronquiolitis en el sur de Europa: análisis de las epidemias 2010-2015

[Epidemiology of patients hospitalised due to bronchiolitis in the south of Europe: Analysis of the epidemics, 2010-2015]. An Pediatr (Barc), Nov. 2017; 87(5): 260-268. Spanish. doi: 10.1016/j.anpedi.2016.10.002. Epub 2016 Nov 17. PMID: 27865727.

12. Vereen S, Gebretsadik T, Hartert TV, Minton P, Woodward K, Liu Z, Carroll KN. Association between breast-feeding and severity of acute viral respiratory tract infection. Pediatr Infect Dis J., Sep. 2014; 33(9): 986-8. doi: 10.1097/INF.0000000000000364. PMID: 24751863; PMCID: PMC4201906.

13. Debnath B, Islam S, Haque N. Prediction of Length of Hospital Stay and Immediate Outcome of Children Suffering From Bronchiolitis on the Bases of Associated Risk Factors. Bangladesh J Infect Dis., 2020; 7(2): 67-71.

14. Schroeder AR, Destino LA, Ip W, Vukin E, Brooks R, Stoddard G, Coon ER. Day of Illness and Outcomes in Bronchiolitis Hospitalizations. Pediatrics, Nov. 2020; 146(5): e20201537. doi: 10.1542/peds.2020-1537. PMID: 33093138.

15. Ridvan Selen, Mehmet Aslan, Erdem Topal, The independent risk factors that affect the hospitalization of acute bronchiolitis. DOI: 10.5455/annalsmedres.2018.11.253

16. Demir A, Özdemir Karadas N, Karadas U. Effect of Breastfeeding and Preterm Births on the Severity of Lower Respiratory Tract Infections and Associated Risk of Hospitalization in Infants and Toddlers. Global Pediatric Health, 2022; 9. doi:10.1177/2333794X221089762

17. Gabriela M Mineva, Helen Purtill, Colum P Dunne, Roy K Philip - Impact of breastfeeding on the incidence and severity of respiratory syncytial virus (RSV)-associated acute lower respiratory infections in infants: a systematic review highlighting the global relevance of primary prevention: BMJ Global Health, 2023; 8: e009693.

18. Alan.Schroeder, A.K.Marmor, Robert.H.Pantell, T.B.Newman, Impact of Pulse Oximetry and Oxygen Therapy on Length of Stay in Bronchiolitis Hospitalizations. Arch Pediatr Adolesc Med., 2004. Scottish Intercollegiate Guidelines Network. Bronchiolitis in children. A national clinical guideline, 2006.

19. G.M. Mussman, M.W.Parker, A.Statile, H.Sucharew, and Patrick W. Brady, Suctioning and Length of Stay in Infants Hospitalized With Bronchiolitis JAMA Pediatr, 2013.

20. Australian Bronchiolitis Guidelines 2025.