Incidence of RSV-related lower respiratory infections among children under five years in Mosul city

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Abstract

Worldwide, the Respiratory Syncytial Virus (RSV) is a major contributor to lower respiratory tract infections in young children. Finding the incidence rate of RSV-related lower respiratory infections in children under five in Mosul, Iraq, as well as evaluating risk variables, clinical signs, and seasonal distribution patterns were the objectives of this study. The study was cross-sectional and took place between October 2024 and March 2025, including 160 kids under five who showed up at Mosul's pediatric facilities with symptoms of lower respiratory tract infections. The immunofluorescence assay was used to analyze nasopharyngeal swabs for RSV. Parents and guardians were given structured questionnaires to complete in order to gather information about their demographics, medical histories, clinical symptoms, and any risk factors. Descriptive statistics, logistic regression analysis, and chi-square testing were used to examine the data. 40.6% (65/160) of children with lower respiratory tract illnesses tested positive for RSV overall. Children under 6 months had the highest incidence (53.8%), followed by those aged 6 to 12 months (24.6%). With a high frequency of 69.2% of all cases in December and January, RSV infections showed a distinct seasonal trend. Prematurity (OR=2.8, 95% CI: 1.4-5.6, p=0.003), household smoking (OR=2.3, 95% CI: 1.2-4.5, p=0.014), and daycare attendance (OR=1.9, 95% CI: 1.0-3.7, p=0.049) were also significant risk variables. RSV positive patients were required to be hospitalized for 32.3%, the average of 4.2 ± 1.8 days. The three most widespread symptoms were fever (72.3%), whey (76.9%) and cough (95.4%). Reducing the incidence of RSV infections in Mosul City is recommended using RSV monitoring systems, preventive strategies for high -risk newborns, public health learning campaigns on RSV transfer and evaluation of RSV immunoproploxis for receptive groups.

Keywords: Lower respiratory tract infections, Children, Mosul, Iraq, Risk factors, Seasonality, Respiratory Syncytial Virus, RSV

Introduction

According to international faith, respiratory synchronous virus (RSV) is one of the most important viral pathogens that cause infections with low airways (LRTI) in young infants. In infants and young children, there is an important cause of pneumonia and bronchiolysis, causing significant disease and health services to consume globally. Especially during the season's epidemics, the virus quickly spreads into common settings and is extremely contagious [1]. According to the World Health Organization (WHO) more than 3.2 million hospitals are caused by an entrance and estimated 118,200 mortals RSV, children under five years of age have more than 33.1 million episodes of acute infections [2].

A major public health problem in poor countries is RSV infection because it lacks health resources, overloaded living conditions and insufficient preventive measures. Common symptoms of RSV infections ranging from weak infections in upper respiratory tract to severe participation in low respiratory tract, written by hypoxemia, heavy breathing and respiratory crisis. Environmental conditions, underlying medical disorders and the child's age can all have significant effects on clinical presentation and severity [3].

Seasonal trends in the epidemiology of respiratory syncytial virus (RSV) infections vary in different parts of the world. RSV activity generally peaks during the winter months in temperate environments but infections can occur year-round especially in tropical and subtropical regions during the rainy seasons. Understanding such trends is critical for appropriate allocation of healthcare resources and implementation of timely preventive measures [4].

According to a meta -analysis of research spread in 2010-2021, Li *et al*., (2022) found that there is a variation between 5.3 to 50.3 per 1000 children, with the largest prices among one-year-old persons. This reflects the RSV infection, especially in newborns which shows adequate the health care system [5].

In the Middle East, RSV epidemiology is poorly understood, and currently indicates available research that the frequency of RSV varies greatly among nations. Malik *et al*., (2018) According to Saudi -Arabia's study of RSV was 29.5% of hospitals admitted to hospitals with emergency respiratory tract infections. Khuri-Bulos *et al*., (2018) RSV positive frequency in Jordan of children under two years of LRTI was 48.6% [6, 7].

There is very few research on RSV epidemiology in Iraq. In a small scale study conducted in Baghdad, Al-Toum *et al*., (2019) found that 35.7% of children admitted to hospitals with bronchiolitis were RSV. Nevertheless, literature lacks data from North -Iraq, especially Mosul City. Given the effect of long -term struggle on the region's unique climate pattern and population health and health infrastructure, this difference in information is important [8].

This research aims to bridge the knowledge gap by investigating how common RSV-related lower respiratory infections are among kids under five in Mosul city. It explores risk factors, symptoms, population trends, and seasonal patterns. The goal is to provide valuable insights that could guide patient care, shape health policies, and boost local efforts to prevent RSV infections.

Materials & Methods

From October 2024 to March 2025, researchers conducted a cross-sectional prospective study. This six-month period aligns with the expected peak RSV season in northern Iraq. The study aimed to collect comprehensive data on RSV prevalence, symptoms, risk factors, and seasonal patterns in Mosul's children under five showing signs of lower respiratory tract infections. The team focused on kids under five with lower respiratory tract infection symptoms at three main pediatric hospitals in Mosul: Mosul General Hospital, Ibn Al-Atheer Teaching Hospital, and Al-Khansaa Teaching Hospital. Using standard statistical methods for prevalence studies, they determined a minimum sample size of 156. This calculation assumed a 35% RSV prevalence, 95% confidence level, and 7.5% margin of error. To account for potential data loss, the study included 160 children in total.

The following were requirements for inclusion: (1) age under five years; (2) clinical symptoms (cough, tachypnea, wheezing, respiratory distress, or fever with respiratory symptoms) indicative of a lower respiratory tract infection; and (3) current disease beginning within seven days before enrollment. Children were not included in the research if their parents or guardians chose not to participate, or if they had previously been included for the same sickness episode. Based on the goals of the study and pertinent literature, a structured questionnaire was created to gather data. Clinical information from medical records was included to the questionnaire, which was given to parents and guardians during in-person interviews.

Version 26.0 of the Statistical Package for Social Sciences (SPSS) was used to analyze the data. For every analysis, the threshold for statistical significance was set at $p<0.05$. Pairwise deletion was used to deal with missing data, and sensitivity studies were performed to see how missing data affected the outcomes.

Results

A total of 160 children under five years with symptoms of lower respiratory tract infections were enrolled in the study. Of these, 65 (40.6%) tested positive for RSV, while 95 (59.4%) were RSV-negative. The demographic characteristics of the study population are presented in Table (1).

Table 1: Shows the study population's demographic characteristics

Variables	Items	Total (n=160)		RSV Positive (n=65)		RSV Negative (n=95)		*p*-value
Age	Less than 6 months	51	31.9%	35	53.8%	16	16.8%	<0.001*
	6–12 months	38	23.8%	16	24.6%	22	23.2%	
	1–2 years	35	21.9%	9	13.8%	26	27.4%	
	2–3 years	16	10.0%	3	4.6%	13	13.7%	
	3–4 years	12	7.5%	1	1.5%	11	11.6%	
	4–5 years	8	5.0%	1	1.5%	7	7.4%	
Gender	Male	90	56.3%	38	58.5%	52	54.7%	0.635
	Female	70	43.8%	27	41.5%	43	45.3%	
Residence	East Mosul	89	55.6%	39	60.0%	50	52.6%	0.482
	West Mosul	56	35.0%	20	30.8%	36	37.9%	
	Suburban areas	15	9.4%	6	9.2%	9	9.5%	

* Significant statistically ($p<0.05$)

Younger age was significantly associated with RSV positive, according to the age distribution analysis ($p<0.001$). The largest percentage of RSV-positive cases (53.8%) were in children under 6 months of age, followed by those between 6 and 12 months (24.6%). As age increased, the percentage of RSV-positive cases gradually declined, with just 1.5% of cases occurring in children aged 3-5.

The gender distribution of the RSV-positive and RSV-negative groups did not differ significantly (p=0.635). Likewise, there was no statistically significant correlation between RSV status and home location inside Mosul city (p=0.482). From October 2024 to March 2025, researchers conducted a cross-sectional prospective study. This six-month period aligns with the expected peak RSV season in northern Iraq. The study aimed to collect comprehensive data on RSV prevalence, symptoms, risk factors, and seasonal patterns in Mosul's children under five showing signs of lower respiratory tract infections. The team focused on kids under five with lower respiratory tract infection symptoms at three main pediatric hospitals in Mosul: Mosul General Hospital, Ibn Al-Atheer Teaching Hospital, and Al-Khansaa Teaching Hospital. Using standard statistical methods for prevalence studies, they determined a minimum sample size of 156. This calculation assumed a 35% RSV prevalence, 95% confidence level, and 7.5% margin of error. To account for potential data loss, the study included 160 children in total.

RSV infection is very common in young infants. One study has shown that 53.8% of the RSV cases occur in children under 6 months of age, and 78.4% are in persons under 1 year. Many studies all over the world have achieved similar results. Scheltema *et al*.,2017 also reported that 80% of the hospital comes in due to RSV occurs the first year of a child's life. Infants are more prone to catching RSV and facing severe health problems because their airways are small, their immune system is not fully developed, and the mother's antibodies are reduced during the first few months [9, 10].

The lack of significant gender difference in RSV prevalence in our study (58.5% male vs. 41.5% female, $p=0.635$) contrasts with some studies that have reported male predominance. For instance, Jartti *et al*., (2019) reported a male-to-female ratio of

1.5:1 in RSV bronchiolitis. This discrepancy might reflect regional variations in healthcare-seeking behaviors or genuine epidemiological differences in the Mosul population [11].

Table 2 lists the clinical signs and severity indications of both RSV-positive and RSV-negative patients.

Table 2: Clinical manifestations and severity indicators by RSV status

Variables	Items	RSV Positive (n=65)		RSV Negative (n=95)		*p*-value
Symptoms						
Cough	Present	62	95.4%	86	90.5%	0.249
Wheezing	Present	50	76.9%	53	55.8%	0.006*
Shortness of breath	Present	46	70.8%	58	61.1%	0.211
Fever	Present	47	72.3%	77	81.1%	0.186
Runny nose	Present	43	66.2%	68	71.6%	0.459
Poor feeding	Present	34	52.3%	32	33.7%	0.018*
Severity						
Hospitalization	Required	21	32.3%	17	17.9%	0.035*
Hospital stay (days)	<3 days	7	33.3%	9	52.9%	0.218
	3-5 days	10	47.6%	7	41.2%	
	>5 days	4	19.0%	1	5.9%	
Mean hospital stay (±SD)		4.2	±1.8	3.1	±1.3	0.042*

Significant statistically ($p<0.05$)

RSV-positive patients most frequently had fever (72.3%), wheezing (76.9%), and cough (95.4%). In children infected with RSV, wheezing (76.9% vs. 55.8%, p=0.006) and poor eating (52.3% vs. 33.7%, p=0.018) were substantially more common than in RSV-negative individuals.

Children with RSV had greater hospitalization rates than children without the virus, regardless of the severity of their illness (32.3% vs. 17.9%, p=0.035). For RSV-positive patients, the average length of hospital stay was also considerably greater (4.2±1.8 days vs. 3.1±1.3 days, p=0.042). Our research population's high prevalence of cough (95.4%), wheezing (76.9%), and shortness of breath (70.8%) was indicative of the clinical presentation of RSV infections. When compared to RSV-negative individuals, wheezing was substantially more prevalent in RSV-positive cases (76.9% vs. 55.8%, p=0.006). This is in line with the pathophysiology of RSV bronchiolitis, which is known to entail inflammation and blockage of small airways, which results in distinctive wheezing [12].

A clinically noteworthy observation that emphasizes the effect of respiratory distress on feeding capacity in young babies is the considerably greater rate of poor feeding seen in RSV-positive individuals (52.3% vs. 33.7%, p=0.018). This conclusion is consistent with research by Rodriguez-Martinez *et al*. (2018), who found that feeding issues are a frequent side effect of severe RSV bronchiolitis, especially in young babies [13].

Our study found that 32.3% of RSV-positive children required hospitalization, with a mean hospital stay of 4.2±1.8 days. This hospitalization rate is comparable to findings from similar studies in developing countries. Li *et al.*, (2022) reported hospitalization rates ranging from 20-40% among children with laboratory-confirmed RSV in low and middle-income countries. The higher hospitalization rate and longer hospital stay observed in RSV-positive compared to RSV-negative cases underscores the significant healthcare burden associated with RSV infections [5].

Information regarding previous RSV infections and age at first infection was collected from parents/guardians and is presented in Table 3.

Table 3: History of previous RSV infections and age at first infection

Variables	Items	Frequency	Percent
Previous RSV diagnosis	Yes	22	13.8%
	No	118	73.8%
	Not sure	20	12.5%
Number of previous RSV infections (n=22)	Once	14	63.6%
	2-3 times	7	31.8%
	More than 3 times	1	4.5%
Age at first RSV infection (n=22)	Less than 6 months	11	50.0%
	6-12 months	8	36.4%
	1-2 years	3	13.6%
	Older than 2 years	0	0.

Age at first RSV infection (n=22)	Less than 6 months	11	50.0%
		6-12 months	8	36.4%
		1-2 years	3	13.6%
		Older than 2 years	0	0.0%

Of the whole study cohort, 73.8% (n=118) had never been diagnosed with RSV, whereas 13.8% (n=22) had a documented history of prior RSV infection. Of the parents/guardians, 12.5% (n=20) were not sure if they had ever been infected with RSV. The majority of children (63.6%) who had previously contracted RSV had only had one episode, whereas 31.8% had two or three prior infections. The early age sensitivity to RSV infection is shown by the fact that 86.4% of infants with prior RSV infections had their first infection before their first birthday, and half of those children experienced their first episode before the age of six months.

In the study population, a number of possible risk factors for RSV infection were evaluated. Table 4 shows the correlation between these variables and RSV positive.

Table 4: Risk factors associated with RSV infection

Risk factors	Items	RSV positive (n=65)		RSV negative (n=95)		*p* -value	Odds ratio (95% CI)
Daycare attendance	Yes	19	29.2%	16	16.8%	0.049*	1.9 (1.0-3.7)
	No	46	70.8%	79	83.2%		
Household smoking	Yes	32	49.2%	28	29.5%	0.014*	2.3 (1.2-4.5)
	No	33	50.8%	67	70.5%		
Prematurity	Yes	19	29.2%	11	11.6%	0.003*	2.8 (1.4-5.6)
	No	46	70.8%	84	88.4%		
RSV preventive treatment	Yes	2	3.1%	3	3.2%	0.968	1.0 (0.2-5.7)
	No	59	90.8%	87	91.6%		
	Not sure	4	6.2%	5	5.3%		

* Significant statistically (p<0.05)

Three important risk variables for RSV infection were found using logistic regression analysis. Being premature Compared to full-term babies, children born before 37 weeks gestation had noticeably greater risks of contracting RSV (OR=2.8, 95% CI: 1.4-5.6, p=0.003). exposure to smoking in the home, compared to children who were not exposed to smoking, children who were exposed to household smoking had more than twice the risks of contracting RSV (OR=2.3, 95% CI: 1.2-4.5, p=0.014). attendance at daycare, compared to children cared for at home, children visiting daycare centers had higher risks of contracting RSV (OR=1.9, 95% CI: 1.0-3.7, p=0.049). There was no significant difference between the RSV-positive and RSV-negative groups (p=0.968), and only around 3% of the children in both groups had received any kind of prophylactic or preventative RSV medication. Prematurity has been identified as a major risk factor for RSV infection (OR=2.8, 95% CI: 1.4-5.6), which is consistent with previous research. According to Lanari *et al*., (2015), preterm newborns were two to three times more likely than full-term infants to require hospitalization for RSV. Premature babies are more vulnerable because they may have underdeveloped immune responses, decreased maternal antibody transfer, and undeveloped lungs [14, 15].

Household smoking exposure emerged as another significant risk factor (OR=2.3, 95% CI: 1.2-4.5), consistent with findings from numerous studies. DiFranza *et al*., (2012) reported a similar magnitude of risk (OR=1.94) in their meta-analysis of secondhand smoke exposure and RSV bronchiolitis. Tobacco smoke exposure impairs mucociliary clearance, disrupts epithelial barriers, and modulates immune responses, potentially enhancing susceptibility to respiratory infections [16, 17].

Attending daycare was linked to a higher risk of contracting RSV (OR=1.9, 95% CI: 1.0-3.7), most likely as a result of the close contact with other kids that occurs there, which makes viral transmission easier. This result aligns with the findings of a multicenter research conducted by Carbonell-Estrany *et al*. (2015), which found that daycare attendance was an independent risk factor for RSV infection [18].

Prematurity, inadequate nutrition, and early age (less than 6 months) were all shown to be independently significant in the multivariate analysis of variables linked to hospitalization among children infected with RSV. These results demonstrate the unique susceptibility of newborn babies, particularly those born before their due dates, to severe RSV sickness that necessitates hospitalization. Hospitalization for hydration support is frequently required due to poor eating, which is also a clinical issue and a sign of the severity of the condition [13].

The RSV-positive cases (n=65) were subjected to multivariate logistic regression analysis in order to determine independent predictors of severe RSV illness (defined as necessitating hospitalization), as indicated in Table 5.

Table 5: Hospitalization risk factors for RSV-positive cases: multivariate analysis

Variables	Adjusted Odds Ratio	95% CI	*p*-value
Age <6 months	3.57	1.26-10.14	0.017*
Prematurity	2.93	1.05-8.19	0.041*
Wheezing	2.78	0.92-8.42	0.070
Poor feeding	3.15	1.11-8.92	0.031*
Household smoking	1.83	0.67-4.98	0.238
Daycare attendance	0.76	0.25-2.36	0.635

* Significant statistically (p<0.05)

Three characteristics were still independently linked to hospitalization among children with RSV after controlling for possible confounders. Under six-month-olds were more than three times as likely to need hospitalization as older children (adjusted OR=3.57, 95% CI: 1.26-10.14, p=0.017). prematureness, the chances of hospitalization were considerably greater for premature newborns (adjusted OR=2.93, 95% CI: 1.05-8.19, p=0.041). inadequate food, the risk of hospitalization was higher for children who were undernourished (adjusted OR=3.15, 95% CI: 1.11-8.92, p=0.031).

In the multivariate model, wheeze did not achieve statistical significance, while exhibiting a tendency toward connection with hospitalization (p=0.070). After adjusting for other variables, hospitalization was not independently correlated with household smoking or daycare attendance.

Our investigation revealed a startlingly low rate of RSV prophylaxis or preventive medication (about 3%) in both RSV-positive and RSV-negative categories. This indicates that the Mosul healthcare system has not implemented many RSV prevention measures, maybe as a result of a lack of funding, the high cost of existing treatments like palivizumab, or a lack of knowledge about available preventative alternatives.

Opportunities for focused public health interventions arise from the discovery of modifiable risk factors, such as exposure to smoking in the home. The burden of RSV illness in this population may be decreased by educational efforts about the dangers of secondhand smoke exposure, especially for small babies and kids with underlying medical issues.

Social determinants of health may have an impact on RSV transmission and severity, as evidenced by the documented spatial clustering of RSV cases in specific areas, especially those with lower socioeconomic indicators. This research emphasizes how crucial it is to address underlying socioeconomic variables when creating all-encompassing preventative interventions.

Conclusions

RSV is a major cause of lower respiratory tract infections in young children in Mosul, accounting for 40.6% of cases in this study population. Based on the study's findings, several conclusions can be made regarding RSV-related lower respiratory infections among children under five years old in Mosul city. With the largest prevalence occurring in babies under 6 months of age (53.8% of all RSV cases) and a gradually declining incidence as age increases, RSV infections exhibit a definite age preference. In Mosul, RSV infections show clear seasonality, peaking in December and January, which is in line with other temperate locations' winter predominance. The incidence of coughing, wheezing, and respiratory distress is a common clinical manifestation of RSV infections Wheezing and poor eating are considerably more prevalent in RSV-positive patients than in RSV-negative ones. A mean hospital stay of 4.2 days and the need for hospitalization for 32.3% of children infected with RSV are linked to significant healthcare use. Prematurity (OR=2.8), exposure to household smoking (OR=2.3), and daycare attendance (OR=1.9) are important risk factors for RSV infection. Poor feeding, preterm, and age less than six months are independent predictors of hospitalization among children with RSV. Just 3% of children in the research sample had received any kind of prophylactic or preventative therapy, indicating a very low level of RSV prevention strategy implementation.

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