



Original Article

New insights on respiratory syncytial virus surveillance in pediatrics- Hospital based cross- sectional observational study

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ABSTRACT

Background With increasing global incidence in children younger than 5 years of age group, Respiratory Syncytial Virus (RSV) found to be the most common viral infection. In comparison to healthy adults, premature infants, young children, elderly and immunocompromised are most likely to present with increased severity. Hence, the aim of our study is to assess the prevalence and risk factors for RSV infection in children under five at a tertiary-care hospital in Salem district.

Materials and Methods: Hospitalized children aged < 5 years with a diagnosis of acute lower respiratory infections (ALRI) admitted between period of October 2022 – December 2024 were included. Nasal & throat swab obtained from 434 cases presenting as a severe ARI taken for molecular analysis of RSV. Ribo nucleic acid (RNA) was extracted using the QiAmp Mini kit, and RSV detection was performed using real-time RT-PCR with manufacturer-specified primers. Data was analyzed using IBM SPSS software.

Results: Among 434 children, 253 were boys and 181 were girls. Age distribution as follows : <1 year (n = 149), 1-2 years (n= 183), 2-5 years (n= 102). RT-PCR confirmed RSV in 69 children (16%), while 365 (84%) tested negative (Figure 2). Among RSV-positive children, 89.8% (n = 62) were born at term, and most had no underlying comorbidities

Conclusion: A prevalence rate of 16% for RSV was recorded in Salem during the present study. It is utmost important to fasten community surveillance for the identification of high-risk patient and initiate effective infection control measures for RSV that will help to reduce the spread among public.

Keywords: Respiratory syncytial virus, RT PCR, Respiratory Infection, Prevalence, Risk Factor.

INTRODUCTION

Respiratory syncytial virus (RSV) is the leading pathogen causing severe acute respiratory tract infections (SARI) in infants and young children. First isolated from chimpanzees in 1955 at the Walter Reed Army Institute of Research in the United

States, RSV was soon identified in young children under five with severe respiratory illness.^{1,2} Since then, RSV has persisted as a highly prevalent and morbid infection in this age group. Current global estimates indicate approximately 66,000 infant deaths and 234,000 deaths in young children annually due to RSV. In developing countries, these deaths account for 99% of the total, highlighting the urgent need for preventive interventions.^{1,3}

RSV belongs to the genus *Pneumovirus* in the family *Paramyxoviridae*. It is an enveloped, filamentous, negative-sense, single-stranded RNA virus. Its envelope, derived from the host cell membrane, incorporates three viral transmembrane glycoproteins: fusion (F), small hydrophobic (SH), and attachment (G) proteins.³ The F protein serves as a major neutralizing antigen critical for viral infectivity. Both F and G proteins are prime targets for novel vaccines and monoclonal antibodies.²

RSV primarily spreads through aerosolized droplets. After inhalation, the virus replicates in the epithelial lining of the nasopharynx and upper respiratory tract, then progresses to the bronchioles and alveoli. Most children present with mild upper respiratory symptoms; however, many develop bronchiolitis or pneumonia. Infants particularly those born prematurely or with bronchopulmonary dysplasia, congenital heart disease, immunodeficiency are at increased risk.² Treatment remains largely supportive. Preventive strategies include hand hygiene, hospital-based personal protective equipment, and passive immunization via monoclonal antibodies.^{2,4,5} Unlike other major lower respiratory tract pathogens, RSV lacks a licensed vaccine, making it one of the world's greatest unmet vaccine needs.⁶

In 2015, the World Health Organization emphasized the urgent need for global, age-specific RSV burden estimates—especially in infants.^{4,5,6} Consequently, this study aims to assess the prevalence and risk factors for RSV infection in children under five at a tertiary-care hospital in Salem district.

MATERIALS AND METHODS

A total of 434 children aged 0-5 years with history of fever and X ray findings who admitted to a government tertiary care hospital at Salem district, Tamilnadu were included from the period of October 2022 – December 2024. Children with empyema, hydro pneumothorax, tuberculosis and history of non-respiratory causes of respiratory distress were excluded in the study. Patients with history of foreign body aspiration are also excluded from the study. The written informed consent was obtained from the caregivers of children. Detailed patient history and clinical observations were recorded. Vital signs and oxygen saturation was monitored and routine laboratory investigations were also performed as per the Pediatrician request. The approval from the Institutional Ethics committee has been obtained (GMKMC&H/114/IEC/2023).

Nasal & throat swab was collected from selected children in viral transport medium (VTM). Then, the sample was carried to Viral Research and Diagnostic Laboratory (VRDL) in transport carrier for testing. Ribo nucleic acid (RNA) was extracted using the QiAmp Mini kit, and RSV detection was performed using real-time RT-PCR with manufacturer-specified primers.

Statistical Analysis

Data were analyzed using IBM SPSS software. A p-value <0.05 was considered statistically significant. Associations between RSV positivity, age, and gender were tested using the chi-square test. The present study shows $p < 0.20$ which indicates insignificant result (Table 1).

Table 1: Statistical analysis using Chi-square test

Gender	Positive		Negative		Sig Value (P Value)
	Count	Percentage	Count	Percentage	
Male	45	65.3%	208	56.9%	<0.20
Female	24	34.7%	157	43.1%	
Total	69	100	365	100	

RESULTS

Study population

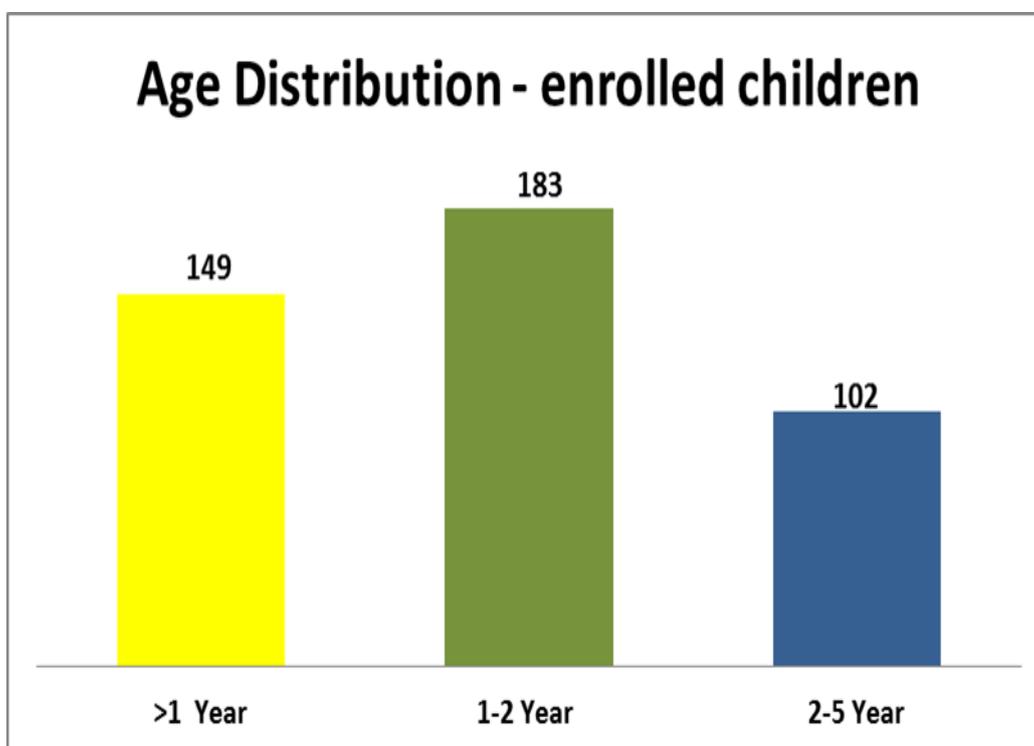
Our study was conducted in a government tertiary care hospital, Salem, Tamil Nadu. A total of 434 children under 5 years of age who got admitted in pediatric ward with feature of Severe acute Respiratory Infection (SARI). Among 434 children, 253 were boys and 181 were girls. Age distribution as follows : <1 year (n = 149), 1-2 years (n= 183), 2-5 years (n= 102) (Figure 1).

RSV Prevalence and Risk Factors

RT-PCR confirmed RSV in 69 children (16%), while 365 (84%) tested negative (Figure 2). Among RSV-positive children, 89.8% (n = 62) were born at term, and most had no underlying comorbidities. Table 2 summarizes the major risk factors identified in this cohort.

Table 2: Major risk factors associated with RSV infection in the present study

Main Risk factors associated with RSV infection	Total count with percentage
Gender (i) Male (ii) Female	45 (65.3%) 24 (34.7%)
Age (i) >1 year (ii) 1-2 years (iii) 2-5 Years	44 (64%) 19 (27%) 6 (9%)
Place of residence (i) Urban (ii) Rural	30 (43.5%) 39 (56.5%)
Supplemental Oxygen support during Admission (i) Yes (ii) No	50 (72%) 19 (28%)
Indoor Air pollutants at home (i) LPG (ii) Fire wood	67 (97%) 2 (3%)
Exposure to Tobacco /smoking (i) Exposure (ii) Non -exposure	17 (24.6%) 52 (75.4%)
X ray findings (i) Positive (ii) Negative	60 (87%) 9 (13%)

**Figure 1: Age distribution of study population**

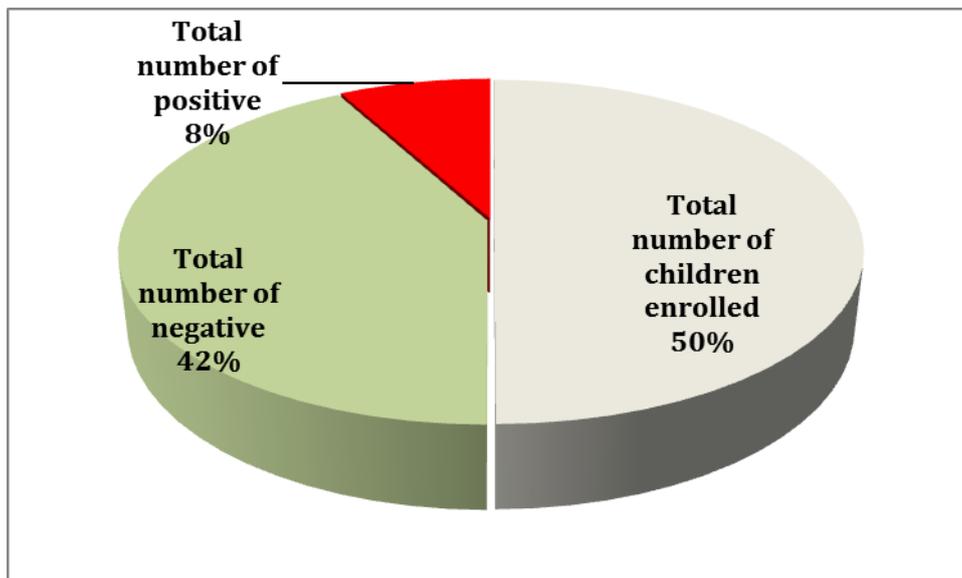


Figure 2: Prevalence of RSV in study population

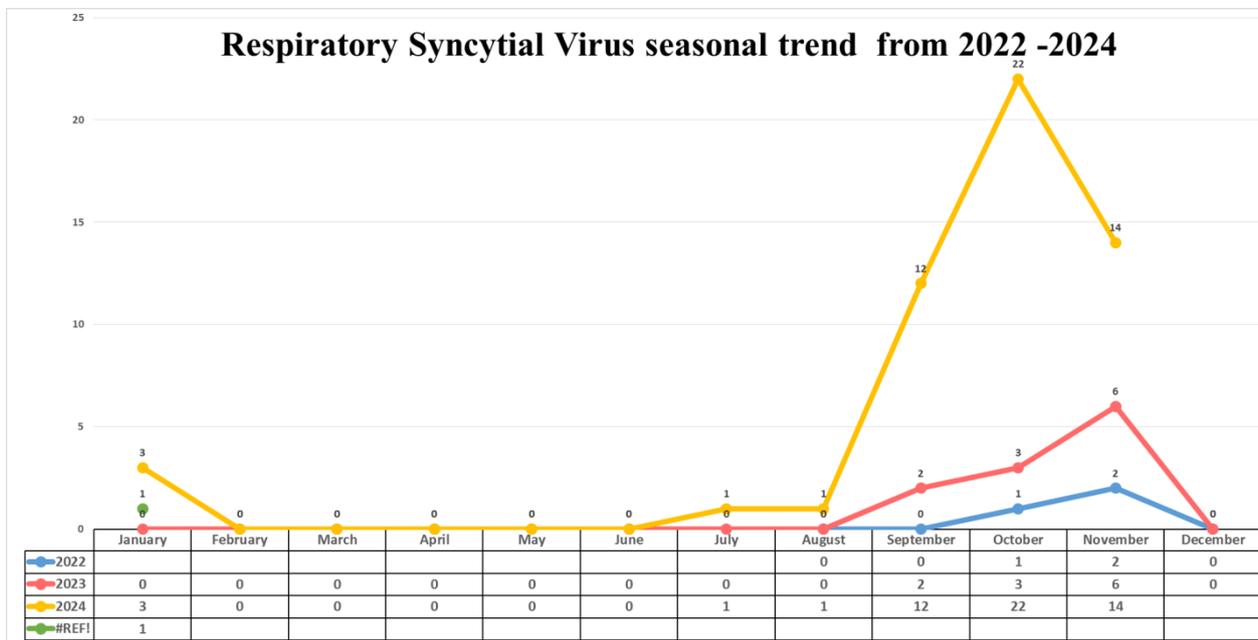


Figure 3: Depicts the seasonal trend of Respiratory Syncytial Virus (RSV) from 2022-2024

DISCUSSION

Viral bronchiolitis is the most common viral illness among infants. Among the various viral pathogens, respiratory syncytial virus (RSV) infection accounts for approximately 70% of cases. After an initial prodrome of nasal congestion and coryza lasting more than three days, bronchiolitis typically develops as the primary clinical feature.^{6,7,8} Subsequently, symptoms such as wheezing, crepitations on auscultation, chest wall retractions, and tachypnea may occur. In infants under six weeks of age, RSV infection accompanied by apnea is a significant indication for hospitalization. Hypoxia and respiratory failure are other major reasons for hospital admission.⁸

In 2015, the World Health Organization (WHO) emphasized the importance of developing global surveillance systems for RSV and generating detailed age-specific estimates to help determine the most appropriate age for immunization. However, information on the prevalence of RSV and its impact on healthy children remain limited, as most research has primarily focused on high-risk populations.⁸

Age remains the biggest risk factor for bronchiolitis. In infants and young children, the airways are very small with low respiratory reserve.⁹ They also presented with impaired respiratory capacity. Risk is higher in infants under 6 months and decreases as age increases. Male gender, prematurity, congenital heart disease and underlying pulmonary disease are also significant associated risk factors.⁹

The gold standard for RSV diagnosis is the RSV isolation, but it takes several days to report. Antigen detection assays such as direct immunofluorescence assays, enzyme immunosorbent assays, optical and chromatographic immunoassays have become popular, but despite their convenience they are inappropriate for diagnostic use in older children and adults with a history of previous infection.^{11,12} However, the antigen load is lower and sensitivity ranges varies and not satisfactory. Real time-PCR has higher sensitivity and specificity compared to other diagnostic assays.¹²

In India, RSV and other respiratory viruses are the major cause for acute lower respiratory Infection (ALRI) in pediatric cases. ALRI found to be principal causes of death among children under 5 years. In India, studies have shown high ALRI incidence rates of 15 per 1000 child in the under-five age group with the incidence being 3.6 times higher among boys as compared to girls. RSV infection in under 5 years causes substantial complications such as respiratory failure, prolonged hospitalization, and high mortality. Previous studies from India reported with prevalence of 11.4% - 26.0%. RSV induced ALRI incidence ranging from 2.4% to 21.2%.¹²

Bharaj et al and Singh et al in their study reported the prevalence rate of RSV of 20.3% and 21.3% respectively.^{13,14} In India, studies from different states like Kolkata, Pune and Chennai presented with prevalence rate of 8.7%, 18.61% and 14.5% respectively. The present study from Salem district of Tamilnadu shows 16% of prevalence rate of selected population. The variation in epidemiology of RSV due to changes in environmental factors, climatic conditions, and severity of its epidemics.¹⁵

In 2010, Nair et al in their recent meta-analysis concluded that the RSV is the most common etiological agent of childhood ALRI & major cause of admission to hospital. The study showed that countries like India, China, Nigeria, Pakistan, and Indonesia all together account for a total of 16 million cases of RSV infections & accounting for half of the global cases of under-5 childhood deaths in the world.¹⁶

In developing countries like India, the routine laboratory diagnoses of viral ALRI remains unobtainable and unexplored to public even in tertiary care centers. In such instances, viral etiology of ALRI largely remains unknown and most cases are empirically treated with antibiotics.¹⁶

The hospitalization rate presents an inversely proportional relationship to age, reaching a maximum in the first months of life. For some, in the first 6 months, there is a greater RSV infection. In the present study, hospitalization with supplemental oxygen is highly observed in babies with less than 1 year (64%) which correlates with RSV positivity (64%). However, few researchers proposed that the highest number of cases is between the first and third year of life.

In the present study, regarding gender, there is a relationship between male gender and RSV infection, Among 434 children, RSV infection was detected positive in 69 (16%) children and 365(84%) to be negative. In the positive group (n = 69), 45(65.3%) were boys and 24(34.7%) were girls which represents a higher percentage of infection. This result is similar to those of other studies that confirm a significantly higher rate. Several other researchers have reported that both sexes are at equal distribution of RSV infection. In 2016 Liu et al documented male dominance in their study.¹⁷ A prospective cohort study by Durani et al reported male predominance (57%) in their study. Radha Krishnan et al also reported a male predominance in their study.¹⁸

In India, Seasonality of RSV starts during the month of June to September and continues till January. Most of the Indian studies report peak of RSV positive cases after rainy and winter season (July–November) & some correlation with low temperature. A study from eastern India reported that first peak of RSV infection in the month of June and second in the month of September.

According to the present study, the seasonal distribution of RSV reaches its maximum peak during the months of September to December (figure 3) which slightly varies with other studies. In relation to the place of residence, there is an increase in the number of RSV hospitalizations in children living in rural areas compared to urban. In addition, exposures of children to tobacco and smoking which may also considered a risk factor and increase the length of hospital stay.¹⁵ The statistical analysis of the present study found to be statistically insignificant (0.20).

Of the various meteorological factors which influence the respiratory tract includes air temperature and humidity. These factors affect local resistance of the human body to infection & involve the respiratory system.¹⁵ Low humidity leads to water loss from the body cells & further paving way to micro fissures in the nasal mucosa during cold weather. Furthermore, cold depresses the movements of cilia in the respiratory tract & increases the vulnerability to infections. In 2019, a study by Hindupur, A., Menon, T. and Dhandapani P revealed that there is a significant positive correlation found between average relative humidity, mean monthly maximum and minimum temperatures and incidence of RSV.¹⁵

Another important risk factor associated with RSV infection is exposure to indoor air pollutants in the home, such as the use of liquefied petroleum gas (LPG) or traditional fuels like wood or coal for cooking. Recent studies have suggested that the use of unvented LPG cook stoves increases the risk of severe pneumonia in infants.²⁰

There are few studies have investigated molecular epidemiology of RSV. Detection of RSV using advanced techniques like real time PCR is growing and with DNA sequencing for RSV strains. In India, Groups A and B RSV have been reported. Different genotypes of Group A (GA2, GA5, NA1 and ON1) and Group B (GB2, SAB4 and BA) have also been described. RSV associated ALRIs, subtype B is found to be more common than subtype A. In India, studies by Nandhini et al. and Agrawal et al. reported that performance of real time RT-PCR in RSV detection was greater compared to that of conventional RT-PCR, supporting the findings of our study.^{21, 22}

RSV as co-infection along with other respiratory infections is highly reported in children under 5 years. Saha S, Pandey BG, Choudekar A, et al in 2015 reported that 90% and 86% of the RSV-associated hospitalization rates in children with ARLIs aged <2 years and <5 years, respectively. Various researchers in their literature review revealed that the there is strongest association between RSV and ALRI, URI, LRTI and influenza which may help identifying the high-risk patients.²³ Children with bacterial co-infections or super infections have increased morbidity and mortality rate. Therefore, early detection of the virus is a critical step in the initiation of proper care, and the prevention of further spread of the virus in community.^{23, 4, 5}

A limitation of our study is the small sample size, which necessitates further research with a larger population to accurately determine the prevalence of RSV and its associated risk factors in our district. In the present study, we included only children who were admitted to our tertiary care hospital for treatment. Nevertheless, the findings of this study may be directly applicable to many similar rural populations, where conducting such research is often challenging.

Globally, higher disease burden due to RSV has kept vaccine development on high priority but development of safe and effective vaccines is still facing scientific challenges. Considering significant prevalence of RSV in Indian children there is a need to provide effective interventions for the prevention of RSV which requires understanding of current dynamics of maternal anti-RSV antibodies, so that necessary preventive measures can be planned and executed.^{4,5}

CONCLUSION

The results obtained in the present study indicate high prevalence of RSV under 5 Years of age group with male dominance. Based on our study results, it is very essential to fasten community surveillance for the identification of high-risk patient and initiate effective infection control measures, which help to reduce the length of hospital stay. It is utmost important to prevent the spread of infection from symptomatic individual by proper sanitation, frequent hand washing, avoiding close contact with RSV-positive individuals, and covering the mouth while sneezing or coughing. Despite highly contagious nature, RSV is a self-limiting infection and could be treated with supportive therapy including hydration, supplemental oxygen & mechanical ventilation in severe cases.

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