ORIGINAL ARTICLE

Acute Respiratory Infections in Children: A Study on Viral Infection Patterns Associated with Age

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ABSTRACT

Introduction: Acute Respiratory Infections (ARIs) are primary drivers of global pediatric morbidity and mortality. Children under five face heightened risks due to immature immune systems and frequent communal exposure. This study investigates the specific relationship between age, clinical severity, and viral infection patterns among children presenting with respiratory symptoms to better understand these vulnerabilities. **Methods:** This cross-sectional study, conducted in suburban Chennai during February and March 2024, enrolled 81 children aged 0–14 years. Nasopharyngeal or throat swabs were analyzed via RT-PCR for common respiratory viruses. Demographic data, symptoms, and disease severity were analyzed using descriptive statistics to assess associations between age and infection patterns. **Results:** Viral pathogens were detected in 13.6% of the samples. Identified viruses included Rhinovirus, Influenza A and B, Adenovirus, Parainfluenza (types 1 and 3), and Respiratory Syncytial Virus (RSV) A. Rhinovirus was the most prevalent pathogen, accounting for 54.4% of positive cases. While clinical severity did not vary significantly across different viral etiologies, it was notably higher in children under four years of age, regardless of the specific virus detected. **Conclusion:** Rhinovirus is a predominant driver of pediatric ARIs in this cohort. Although various viral types show similar clinical presentations, children under four represent the most vulnerable demographic for severe illness. Further research with larger, more diverse cohorts is essential to refine age-specific management and intervention strategies.
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INTRODUCTION

Acute Respiratory Infections (ARIs) are among the most prevalent illnesses affecting children globally, representing a significant cause of morbidity and mortality (1). These infections exert substantial pressure on healthcare systems and create considerable distress for affected families. The majority of ARIs in children have a viral etiology, which underscores the importance of understanding the viral pathogens involved and their impact on pediatric health (2). Children, particularly those under the age of five, are disproportionately affected by respiratory infections compared to adults (3). This increased susceptibility can be attributed to several factors. Young children have underdeveloped immune systems, which are not fully equipped to combat the wide array of pathogens they encounter. This immaturity results in a higher incidence of infections and more severe disease courses. Children frequently come into contact with various pathogens in communal settings such as daycare centers and schools. These environments facilitate the spread of infectious agents due to close physical contact and shared spaces with other children with immature immune systems. The anatomical structure of children's respiratory tracts differs from that of adults. For instance, the airways in children are narrower, making them more susceptible to blockages and complications from infections such as bronchiolitis and pneumonia (4,5). The clinical manifestations of ARIs in children can range from mild symptoms to severe, life-threatening conditions. Infants and young children are particularly at risk for severe outcomes, including hospitalization and respiratory

distress. Complications such as pneumonia and bronchiolitis are highly recorded in infants and can lead to significant morbidity (6). These severe manifestations highlight the need for effective management strategies tailored to pediatric populations. By identifying the specific viruses responsible for ARIs and understanding their epidemiology, healthcare providers can develop targeted treatment protocols and management strategies. Such insights can reduce the misuse of antibiotics and improve patient outcomes. Knowledge of the prevalent viral agents and their seasonal variations can inform public health interventions, including vaccination campaigns and hygiene practices, aimed at prevention rather than cure. This study aims to investigate the relationship between age, clinical severity, and infection patterns in respiratory infections among children. By analyzing data from a cohort of children aged 0-14 years presenting with respiratory symptoms, we seek to identify common viral pathogens during the study period and to assess their distribution across different age groups and variation in clinical manifestations based on age.

MATERIALS AND METHODS

This is a cross-sectional study done during February and March 2024 at a primary healthcare setting in suburban Chennai. All children aged 0-14 years, attending the outpatient clinic with respiratory symptoms during the study period were included. A standardized translated questionnaire was used to collect information including the lab investigation form. Approval of the Institutional Ethical Committee was obtained (UG/SRB/SMCH/112201145). Informed consent was obtained from the parents/guardians of the participants. This study aims to investigate the relationship between age, clinical severity, and infection patterns in respiratory infections among children. A total of 81 nasopharyngeal and throat swabs were collected from children presenting with respiratory symptoms. Demographic details, symptoms and signs, and any relevant medical history were collected. The inclusion criteria were: Children with respiratory complaints like cough, cold, sore throat etc. with or without fever were included in the study. The exclusion criteria were: Children with underlying chronic respiratory conditions (TB, asthma), foreign body inhalation, or any other chronic conditions (cancer) were excluded from the study. The severity of the disease was assessed in three categories: mild Moderate and those requiring hospitalization. Each participant underwent nasopharyngeal or throat swab sampling, and the samples were tested for common respiratory viruses using commercially available RT-PCR kits.

Statistical analysis

The overall collected data encompassed demographic information, clinical symptoms, and disease severity. Descriptive statistics were employed to analyze the prevalence of viral pathogens, and the association between age, infection patterns, and clinical severity was assessed. A descriptive analysis was done using Microsoft® Excel for Mac, version 16.16.27 and variables like age, gender, infection pattern and symptomatology were analyzed Chi-square test was used to assess the association between age and infection severity, with a p-value < 0.05 considered statistically significant.

RESULTS

Age Distribution of Participants

A total of 81 nasopharyngeal and throat swab samples were collected from children presenting with respiratory symptoms. The majority of participants were aged 10–14 years (n = 31), followed by 5–9 years (n = 23), 1–4 years (n = 17), and below 1 year (n = 10) (Table I).

Sample collection in younger children, particularly those below 5 years of age, was challenging due to limited cooperation. Overall, 9 nasopharyngeal swabs, 17 throat swabs, and 55 combined nasopharyngeal and throat swabs were obtained across all age groups.

Table I: Type and number of swabs collected from participants across age groups.

Age	Nasopharyngeal Swab only (p. value)	Throat swab only (p. value)	Both (p. value)	Total
< 1 Year	2 (0.50)	6 (7.44)	2 (3.30)	10
1 - 4	5 (4.13)	3 (0.08)	9 (0.51)	17
5- 9	2 (0.23)	5 (0.01)	16 (0.02)	23
10-14	0	3 (1.99)	28 (1.99)	31
Total	9	17	55	81

Detection of Respiratory Viruses

Out of the 81 samples, 11 (13.6%) tested positive for at least one respiratory virus. The detected viruses included Rhinovirus, Influenza A, Influenza B, Parainfluenza viruses, and Respiratory Syncytial Virus (RSV).

Rhinovirus was the most frequently identified virus (n = 6), followed by Influenza B (n = 2), RSV A (n = 2), and Influenza A (n = 1). No cases of H1N1 or parainfluenza viruses were detected. The distribution of viral infections across age groups is presented in Table II .

Age Distribution of Viral Infections

Among the positive cases, the majority were observed in children aged 5–14 years. Rhinovirus was the predominant pathogen, accounting for 54.5% of all detected infections and showing the highest frequency in the 10–14 years age group.

In children aged 1–4 years, an equal distribution of Rhinovirus, Influenza A, Influenza B, and RSV A was observed. In contrast, RSV A was the only virus detected in children below 1 year. The distribution pattern of viral infections across age groups is illustrated in Figure 1.

Table II: Distribution of detected viruses by age group. Abbreviations: RSV – Respiratory Syncytial Virus.

Age Group	Rhino Virus	Influenza A	Influenza B	H1N1	Influenza A +H1N1	Para Influenza 1	Para Influenza 2	RSV A	Total positive for any virus (*p* value)	Samples from different Age Group
<1 year	0	0	0	0	0	0	0	1	1	10
1-4 Years	1	1	1	0	0	0	0	1	4	17
5-9 years	2	0	1	0	0	0	0	0	3	23
10-14 Years	3	0	0	0	0	0	0	0	3	31
	6	1	2	0	0	0	0	2	11	81

Note: '0' indicates virus tested but not detected. All listed viruses were included in the RT-PCR panel.

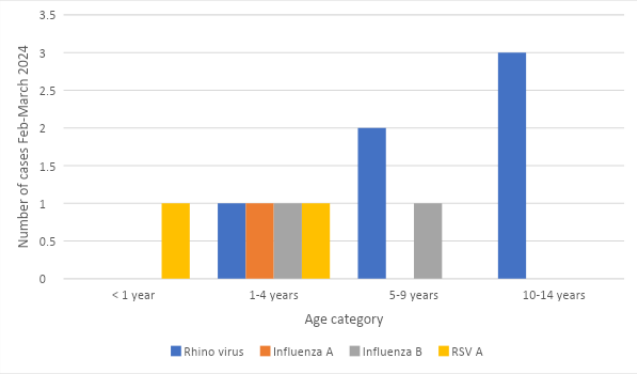

Figure 1: Distribution of viral infections among children by age group. X-axis represents age groups; Y-axis shows number of positive cases for each virus.

Gender Distribution of Participants and Infections

Of the total participants, 42 were female and 39 were male (Table III). The age distribution between genders was comparable across all groups.

Rhinovirus infections were slightly more common in females compared to males; however, no statistically significant differences were observed in infection rates or clinical severity between genders or across different viral infections.

Clinical Severity

One child required referral for hospitalization due to severe clinical presentation. Notably, clinical severity was also observed among children who tested negative for viral pathogens, particularly in the 0–4 years age group, where a statistically significant association was identified ($p < 0.05$).

Table III: Distribution of age and gender of participants with viral respiratory infections.

Age	Male	Female	Total
< 1 Year	4	6	10
1 - 4	9	8	17
5- 9	11	12	23
10-14	15	16	31
Total	39	42	81

DISCUSSION

According to the previous study, acute respiratory infections are the most frequently occurring in children about six to eight times annually (7). Most of these infections are targeted children of 5 years above mainly by the two primary viruses, respiratory syncytial virus types A and B (RSV A and B) and rhinovirus (RVs) (8). A combination of factors associated with age, seasonal variations and health practices primarily influences these respiratory infections in children. Seasonal variations play a significant role in the clinical presentation of viral infections. Researchers have observed that rhinovirus circulates year-round in various climatic regions, with occasional spikes during autumn and winter (9). A study conducted in Croatia found that rhinovirus infections were more prevalent during the autumn and winter (10). Similarly, in Finland it was found that the incidence of rhinovirus infections in children aged 0 to 14 years remained relatively stable from January 2019 to March 2020 (11). In comparison to this, our study showed a similar peak of rhinovirus infection in February and March 2024. The Rhinovirus specifically were pointed out in the children of 5 years and above and the research in Mexico examined the clinical and molecular characteristics of infections within the Mexican populations. In children, 79 % (383 cases) occurred in those aged ≤5 years (12). Further, study depicted the common infection that occurred between similar age groups was rhinovirus (13). Compared to our study, which also focuses on pediatric respiratory infections, the findings highlight a similar trend, where the majority of participants were in the age (66.6%) 5 to 14 years and showed high positive cases of rhinovirus, this highlights the importance of considering older children in studies of respiratory infections, as they can act as reservoirs for the viruses, spreading them within households and communities. Among the children infected with Rhinovirus, those aged 0 to 4 years exhibited clinical severity, although this finding was not statistically significant. However, it was noted that even children who tested negative for viral pathogens experienced significant clinical severity, particularly in the 0 to 4 years age group ($p < 0.05$), further emphasizing the vulnerability of this age group to respiratory infections across different populations.

In 2020, data revealed that 30% to 50% of children were positive for rhinovirus. Clinically, researchers suggest that rhinovirus is a significant trigger for acute wheezing and Asthma exacerbation in children (14). Also, when compared to the study by (15) which also showed positive cases of rhinovirus (69%) out of 89 samples Despite sample size restriction, out of 81 samples our study showed (13.6%) positive cases of rhinovirus. On the other hand, it is important to focus on hygienic practices to prevent such infections among children. In the case of hygiene practices, healthcare providers should be vigilant in monitoring and treating young patients to prevent complications. Educating parents and caregivers about the signs and symptoms of respiratory infections and the importance of seeking prompt medical care can help in early intervention and management, thereby reducing the risk of severe outcomes (16). Promoting routine childhood vaccinations against common respiratory pathogens, such as influenza, can significantly reduce the incidence and severity of ARIs. Additionally, encouraging good hygiene practices, such as frequent handwashing, covering coughs and sneezes, and avoiding close contact with sick individuals, can help prevent the spread of infections. In a recent study, it was reported that the incidence of co-infection was also high among the pediatric age group (17). The study underscores the need for larger sample sizes and further research to elucidate the nuanced relationship between age and infection severity. Ongoing surveillance and research are essential for adapting public health strategies and clinical practices to the evolving landscape of pediatric respiratory infections. By addressing these recommendations, healthcare providers and public health officials can enhance the management and prevention of respiratory infections in children, ultimately improving health outcomes for this vulnerable population.

CONCLUSION

In conclusion, our study highlights the prevalence of viral respiratory infections among children aged 0-14 years, with Rhinovirus being the most commonly identified pathogen. The findings underscore the need for enhanced diagnostic tools and strategies to differentiate viral from bacterial infections. A larger cohort would provide more robust data, allowing for more definitive conclusions and potentially uncovering subtler patterns and associations that were not evident in this study. The small sample size also affects the statistical power of the study, making it challenging to detect significant differences. Early recognition and management of symptoms are crucial in reducing morbidity and improving outcomes in this vulnerable population. Future research should focus on larger, more diverse cohorts and consider seasonal variations to better understand and mitigate pediatric respiratory infections.

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