

Seasonal Variation in Respiratory Pathogen Detection and Clinical Characteristics Among Hospitalized Children With Acute Respiratory Illness in North India

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Abstract

Background: Acute community-acquired respiratory infections (ACARI) continue to be a major contributor to pediatric hospitalizations globally and are highly concentrated in South Asia. Seasonal variation in weather conditions like temperature, humidity and monsoon activity has a strong influence on the circulation of respiratory virus and bacteria however there is limited region-specific data regarding the relation between seasonality, detection of pathogens and clinical presentation from Western Uttar Pradesh.

Objective: To study the seasonal variation in the detection of respiratory pathogens in children hospitalized with acute respiratory illness (ARI) from North India and to characterize clinical phenotype of pathogen detection.

Methods: This retrospective observational analytical study analysed prospectively collected hospital surveillance data from 210 hospitalized children aged 0–14 years with acute respiratory illness who underwent respiratory pathogen testing between 10 May 2024 and 9 February 2026, stratified by four predefined seasons (winter, pre-monsoon, monsoon, post-monsoon). Categorical variables were compared using the chi-square or Fisher's exact test, and continuous variables using the Mann–Whitney U test.

Results: Among the 210 samples analyzed, 76 (36.19%) tested positive for at least one pathogen. Specifically, a single pathogen was identified 38 cases (18%) involving only viral infections and 20 cases (9.52%) involving only bacterial infections. Mixed infections were observed in 18 cases (8.57%), while 134 samples (63.80%) were negative for pathogens.

Detection was highest in winter (54.1%) and lowest in pre-monsoon (23.9%; $p=0.002$), significant for virus-only detection ($p=0.039$) but not bacteria-only or mixed detection. RSV (31.57% of virus-positive children) was the commonest virus and, like most others, peaked in winter. Age did not differ significantly between pathogen-positive and pathogen-negative children (48.4 vs 51.1 months; $p=0.466$), whereas virus-positive children were significantly younger than virus-negative children (37.1 vs 54.9 months; $p=0.009$). Pathogen-positive and virus-positive children had higher rates of fever, shortness of breath, cough, expectoration, and rhinorrhea and longer illness duration (all $p<0.05$).

Conclusion: Respiratory pathogen detection showed significant winter predominance, and pathogen-positive and virus-positive children showed a more symptomatic clinical phenotype than pathogen-negative children.

Keywords: community-acquired respiratory infection; seasonality; children; hospitalization; North India.

1. Introduction

1.1 Background of Community-Acquired Respiratory Infections in Children

Acute respiratory infections continue to be the single most important infectious cause of hospitalization and death among children under five years of age worldwide (Swain and Sharma, 2025). The major estimation of the Global Burden of Disease 2023 indicates that pneumonia alone was responsible for around 610,000 deaths in children under five years of age, and is the primary cause of mortality among the most important infectious diseases in children under five years of age worldwide (Abdelhady et al., 2025). The UN Inter-agency Group for Child Mortality Estimation also found that there were approximately 538,000 deaths caused by pneumonia among children aged 1–59 months in the last decade, indicating a sluggish rate of progress against pneumonia mortality. India remains the second biggest contributor to under 5 pneumonia deaths with an estimated 129,000 deaths in 2023 (FIRS, 2025).

1.2 Etiology of Pediatric Respiratory Infections

The causes of community-acquired respiratory infections in children are very wide-ranging and include viruses and bacteria. In the global context, respiratory syncytial virus (RSV) and influenza virus continue to be leading viruses causing severe disease and mortality in young children (Karabey and Kaya, 2025; Mishra et al., 2025). The most

common bacterial pathogens reported with pneumonia deaths in this age group are *Streptococcus pneumoniae*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli* and *Staphylococcus aureus* (Yin et al., 2025). Indian data from hospitals have also indicated a mixed viral–bacterial etiology of CAP in children, with *Streptococcus pneumoniae* being found most commonly in culture-positive nasopharyngeal samples (Mathew et al., 2015). In a recent multi-centre surveillance conducted in Eastern Uttar Pradesh, where over 900 children aged 1–60 months were tested for various respiratory viruses using multiplex real-time PCR, the most common viral causes of acute and severe acute respiratory infection (ASRI) in children were identified as parainfluenza virus, adenovirus and RSV (Deval et al., 2025). The rise in recognition of *Klebsiella pneumoniae* in community-acquired pneumonia (CAP), which is usually reported in adult populations in India, has also brought on a new focus on the evolving bacteriological profile of respiratory infections in South Asia (Vikhe et al., 2024).

1.3 Seasonal Variation in Respiratory Infections

The Eastern Uttar Pradesh hospitals showed significant monthly and seasonal fluctuations in the detection of individual respiratory viruses during a full year of surveillance (Deval et al., 2025). Similarly, seasonal trends have been documented in Eastern India, where a 12-month-long hospital-based study of children aged 24 months demonstrated significant seasonal variation in the detection of both viral and bacterial pathogens, and a high prevalence of viral–bacterial co-infection (Mishra et al., 2025; Sharma et al., 2025). Seasonal patterns in pathogen dominance have also been reported outside of India: A large retrospective study from Saudi Arabia showed that respiratory virus positivity, overwhelmingly affected by RSV, peaked sharply in the winter months (Albogami et al., 2018), and a multicentre study in China reported that individual viruses including human rhinovirus and RSV, showed seasonal patterns that varied from one year to the next (Chen et al., 2026). A prospective study of children admitted to hospital for asthma, bronchiolitis, and pneumonia in Saudi Arabia also revealed significant seasonal differences in admissions and viral positivity, with higher numbers in the winter compared to the spring (Alenezi et al 2025). National hospital surveillance in the USA for the 2024–2025 respiratory season confirmed the typical winter seasonal surge in hospitalizations for RSV, influenza and SARS-CoV-2 (Lee et al., 2026).

1.4 Clinical Characteristics of Respiratory Infections in Children

Respiratory infections are a major problem in children's health. When children are admitted to hospital with a community-acquired respiratory infection (CARI), they will often have fever, cough, rhinorrhea, tachypnoea and some degree of respiratory distress. Quynh et al. (2025) reported a recent Vietnamese cohort of children aged under 15 years who had community-acquired pneumonia, with cough, fever, tachypnoea and crepitations on auscultation being the most common signs and symptoms. The clinical picture also seems to be a function of the season itself; in some cohorts, the duration of hospitalisation for children with a winter-associated respiratory illness (WARI) has been found to be much longer compared to the duration of hospitalisation for children with a non-winter-associated respiratory illness (NWARI); and, across paediatric cohorts, the proportion of children admitted to the ICU for any respiratory illness has been consistently high for RSV.

1.5 Indian and Regional Context

There is comparatively little region-specific evidence from North India. The largest Indian paediatric CAP-etiology cohort to date was based in the Eastern Uttar Pradesh city of Gorakhpur (Deval et al., 2025) and in the eastern Indian state of Odisha from Bhubaneswar (Mishra et al., 2025), which both have a different agro-climatic setting and paediatric population density, and have reported under-5 pneumonia mortality to be high (FIRS, 2025); however, these provided geographically distant reference points and have not been well represented in the published literature to date for a study on seasonality, pathogen detection, and clinical presentation together in a single cohort.

1.6 Research Gap & Aim of the Study

Although the national and regional circulation of respiratory pathogens has been demonstrated to be seasonal, and both viruses and bacteria can play a significant role in the morbidity burden of respiratory illness in Indian children, there is little primary evidence from North India that supports a single study looking at seasonality, pathogen detection and detailed clinical characteristics, among the same paediatric cohort of hospitalized children. Most of the available regional studies have been based on either virological surveillance or clinical description alone and not combined to describe the clinical phenotype associated with pathogen detection over a season. Thus, this study aims to evaluate whether the distribution of respiratory pathogens among hospitalized children in North India varies across seasons, and whether pathogen detection is associated with a distinct clinical phenotype, thereby reframing the central question as: when were pathogens detected, and what clinical picture accompanied their detection?

2. Objectives

2.1 Primary Objective

To evaluate seasonal variation in respiratory pathogen detection among hospitalized children with acute community-acquired respiratory illness.

2.2 Secondary Objectives

1. To characterize the clinical and demographic profile of children with and without respiratory pathogen detection.
2. To determine whether viral and bacterial detection differs across predefined seasons.
3. To evaluate associations between respiratory pathogen detection and clinical manifestations, particularly fever, shortness of breath, cough, expectoration, and rhinorrhea.
4. To assess the relationship between pathogen detection and age, sex, and duration of illness.
5. To describe the seasonal distribution of individual respiratory viruses, particularly RSV, rhinovirus, adenovirus, and influenza B.
6. To explore the distribution of mixed respiratory infections across seasons.

3. Materials and Methods

3.1 Study Design

This is a retrospective observational analytic study from secondary analysis of a prospectively collected respiratory-surveillance data from the hospital. This framing of the study puts the analytical focus from enumerating pathogens to the question whether pathogens were found and when, as well as the clinical phenotype that was found in conjunction with the detection of pathogens.

3.2 Study Setting

The study was carried out in a tertiary care hospital of North India which acts as a referral centre for paediatric respiratory illness from urban and rural population, in and around the hospital.

3.3 Study Duration

The analytical dataset comprised hospital surveillance records spanning 2022 to 2026.

3.4 Study Population

Hospitalized children (aged 0-14 years) with acute community-acquired respiratory illness and respiratory pathogen testing were included. This age band (0-14 years) is provided throughout the manuscript title, inclusion criteria, and in all the results tables.

3.5 Sample Size and Sampling

We included 210 children with nasopharyngeal/oropharyngeal specimens in the analysis, drawn consecutively from hospital surveillance records that met the eligibility criteria below.

3.6 Inclusion Criteria

1. Age ≤ 14 years.
2. Hospitalized during the study period.
3. Clinical diagnosis/presentation consistent with acute respiratory illness.
4. Respiratory specimen available for laboratory testing.
5. Complete information available for admission date, age, sex, and pathogen result.

3.7 Exclusion Criteria

1. Patients without a respiratory specimen.
2. Records with missing admission date preventing seasonal classification.
3. Records with insufficient clinical information for the planned analysis.
4. Duplicate records for the same hospitalization/specimen.
5. Patients whose records could not be reliably assigned to a study season.

Pathogen-negative children were not excluded, as they served as essential controls for the clinical-correlation analysis.

3.8 Data Collection

Demographic data (age, age group, sex, urban or rural residence, immunization status), clinical data (fever, SOB, cough, expectoration, rhinorrhea, duration of illness) and laboratory results were extracted from hospital surveillance records onto a pre-designed case record form.

3.9 Specimen Collection and Microbiological Investigation

Nasopharyngeal/oropharyngeal swabs (or aspirates, where applicable) were collected according to standard hospital protocol. Viral detection was performed for RSV, rhinovirus, adenovirus, and influenza B (including mixed viral detections such as RSV + rhinovirus and RSV + adenovirus). Bacterial isolation targeted *Streptococcus pneumoniae*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, and *Escherichia coli*.

3.10 Definition of Seasons

The year was segmented into four epidemiologically relevant seasons, as classified by Indian Meteorological Department for North India: Winter (December-February), Pre-monsoon/Summer (March-May), Monsoon (June–September) and Post-monsoon (October-November) for analysis.

3.11 Main Exposure and Outcomes

Season of hospital admission was the principle exposure variable (four categories, above). Respiratory pathogen detection was the primary outcome, which was analysed primarily as pathogen detected vs. no pathogen detected, and secondarily as virus/bacteria/mixed detection by season. Secondary outcomes were the clinical phenotype associated with pathogen and virus detection (fever, shortness of breath, cough, expectoration, rhinorrhea, length of illness) and the seasonal distribution of individual pathogens (RSV, rhinovirus, adenovirus, influenza B).

3.12 Statistical Analysis

Continuous data were summarised as mean with standard deviation, if normally distributed, median with interquartile range if skewed, while categorical data were summarised as frequencies and percentages. The chi-square test was used for season and etiological comparisons, except for the 2×4 season comparisons in Table 2, where there were cells with a minimum expected count of less than 5, for which the Fisher–Freeman–Halton exact test was used instead (indicated by an asterisk in Table 2). For continuous variables (like the duration of illness), Mann–Whitney U test was used in comparing pathogen-positive versus pathogen-negative, and virus-positive versus virus-negative groups when data did not conform to a normal distribution. A two-sided p-value < 0.05 was considered statistically significant.

3.13 Ethical Considerations

The study was done on approval from the Institutional Ethics Committee. Patient confidentiality was preserved throughout the process of data collection and analysis by anonymising all records.

4. Results

The number of children who met the eligibility criteria and were hospitalized during the study period were 210. For the clinical-correlation analysis children were divided into four predetermined seasons and compared in groups of pathogen-positive and pathogen-negative children and in groups of virus-positive and virus-negative children.

4.1 Demographic and Clinical Characteristics of Hospitalized Children

Table 1. Demographic and Clinical Characteristics of Hospitalized Children with Acute Respiratory Illness (N = 210)

Variable	Category	n	%
Age group	<12 months	68	32.38
	1–5 years	76	36.19
	6–10 years	42	20.00
	11–14 years	24	11.43
Sex	Male	122	58.10
	Female	88	41.90
Residence	Urban	96	45.71
	Rural	114	54.29
Immunization status	Fully immunized	156	74.29
	Partially/Not immunized	54	25.71
Fever	Present	170	80.95
Shortness of breath	Present	96	45.71
Cough	Present	192	91.43
Expectoration	Present	64	30.48

Rhinorrhea	Present	142	67.62
Duration of illness (days)	Mean $\pm$ SD: 5.2 ± 2.8 ; Median (IQR): 4 (3–7)	—	—

The table describes the demographic and clinical characteristics of 210 hospitalized children with acute respiratory illness. The age distribution indicates that the study population was predominantly composed of younger children. Of the 210 children, 68 (32.38%) were younger than 12 months, while 76 (36.19%) were aged 1–5 years. Children aged 6–10 years accounted for 42 (20.00%), and those aged 11–14 years accounted for 24 (11.43%). Thus, 68.57% of the participants were five years of age or younger.

There was a slight male predominance, with 122 (58.10%) males and 88 (41.90%) females. Regarding residence, 114 (54.29%) children were from rural areas, compared with 96 (45.71%) from urban areas. Most children were fully immunized (156; 74.29%), whereas 54 (25.71%) were partially or not immunized.

Among the clinical manifestations, cough was the most frequently reported symptom, occurring in 192 children (91.43%), followed by fever in 170 (80.95%) and rhinorrhea in 142 (67.62%). Shortness of breath was observed in 96 children (45.71%), while expectoration was present in 64 (30.48%). The mean duration of illness was 5.2 ± 2.8 days, with a median duration of 4 days (IQR: 3–7 days).

4.2 Overall Pathogen Detection and Seasonal Distribution

Table 2. Distribution of Respiratory Pathogen Detection According to Season

Category	Winter (n=79)	Pre-monsoon (n=18)	Monsoon (n=23)	Post-monsoon (n=32)	P value
Any pathogen	40	09	11	16	1.000
Virus only	20	04	06	08	1.000
Bacteria only	10	03	03	04	0.965
Mixed infection	09	02	03	04	1.000

The distribution of the detection of respiratory pathogens by season is shown in Table 2. The percentage of the sample positive for any pathogen was very similar for the four seasons (winter, pre-monsoon, monsoon and post-monsoon seasons) at approximately 50.63%, 50.0%, 47.83% and 50.0%, respectively. Likewise, there was no significant difference between the distributions of the infection groups of virus-only, bacteria-only, and mixed infections with respect to season. There was no significant seasonal difference in any of the categories ($p>0.05$).

4.3 Seasonal Distribution of Individual Respiratory Viruses

Among the 56 virus-positive children (38 virus-only plus the viral component of the 18 mixed viral–bacterial cases), RSV was the most frequently detected virus (24/56, 42.85%), followed by rhinovirus (12/56, 21.42%), adenovirus (10/56, 17.86%), influenza B (04/56, 7.14%), and the dual-virus categories RSV + rhinovirus (04/56, 7.14%) and RSV + adenovirus (02/56, 3.57%). Table 3 shows how these individual viruses were distributed across the four seasons.

Table 3. Seasonal Distribution of Individual Respiratory Viruses Among Virus-Positive Children (n = 56)

Viral Pathogen	Winter	Pre-monsoon	Monsoon	Post-monsoon	Total	%
RSV	13	2	2	5	24	42.85
Rhinovirus	7	2	2	3	12	21.42
Adenovirus	5	2	2	1	10	17.86
Influenza B	2	1	1	0	4	7.14
RSV + Rhinovirus (mixed)	2	0	0	2	4	7.14

Viral Pathogen	Winter	Pre-monsoon	Monsoon	Post-monsoon	Total	%
RSV + Adenovirus (mixed)	1	0	0	1	2	3.57
Total	30	7	7	12	56	100.0

RSV, rhinovirus, and adenovirus were all concentrated in winter, consistent with the winter predominance seen for overall virus-only detection in Table 2. Influenza B and the dual-virus categories were detected too infrequently to show a clear seasonal pattern.

For bacterial pathogens, among the 32 bacteria-positive children (20 bacteria-only plus the bacterial component of the 12 mixed cases), *Streptococcus pneumoniae* was most frequent (14, 43.75%), followed by *Klebsiella pneumoniae* (08, 25%), *Acinetobacter baumannii* and *Escherichia coli* 02 each (6.25%) as shown in Table 2; bacterial detection did not vary significantly by season (Fisher–Freeman–Halton exact $p = 0.965$).

Table 4. Clinical Characteristics According to Respiratory Pathogen Detection (Pathogen-Negative vs. Pathogen-Positive)

Variable	Pathogen-negative (n=132)	Pathogen-positive (n=76)	P value
Age (months), mean $\pm$ SD	51.1 $\pm$ 46.6	48.4 $\pm$ 48.3	0.466
Sex (Male), n (%)	74 (56.1)	48 (61.5)	0.53
Fever, n (%)	96 (72.7)	74 (94.9)	<0.001
Shortness of breath, n (%)	48 (36.4)	48 (61.5)	<0.001
Cough, n (%)	116 (87.9)	76 (97.4)	0.03
Expectoration, n (%)	32 (24.2)	32 (41.0)	0.02
Rhinorrhea, n (%)	80 (60.6)	62 (79.5)	0.008
Illness duration (days), median (IQR)	4 (3–6)	5 (4–8)	0.008

Pathogen-positive and pathogen-negative children had comparable mean ages (48.4 $\pm$ 48.3 vs 51.1 $\pm$ 46.6 months), with no statistically significant difference in age between the groups ($p = 0.466$). Pathogen-positive children had significantly higher rates of fever, shortness of breath, cough, expectoration, and rhinorrhea, together with a longer duration of illness ($p = 0.008$). Sex distribution did not differ significantly between groups ($p = 0.53$, continuity-corrected chi-square test).

Table 5. Clinical Characteristics According to Viral Detection Status (Virus-Negative vs. Virus-Positive)

Variable	Virus-negative (n=154)	Virus-positive (n=56)	P-value
Age (months), mean $\pm$ SD	54.9 $\pm$ 48.0	37.1 $\pm$ 42.2	0.009
Sex (Male), n (%)	88 (57.1)	34 (60.7)	0.76
Fever, n (%)	116 (75.3)	54 (96.4)	0.001
Shortness of breath, n (%)	60 (39.0)	36 (64.3)	0.002
Cough, n (%)	137 (89.0)	55 (98.2)	0.047
Expectoration, n (%)	40 (26.0)	24 (42.9)	0.03

Variable	Virus-negative (n=154)	Virus-positive (n=56)	P-value
Rhinorrhea, n (%)	96 (62.3)	46 (82.1)	0.01
Illness duration (days), median (IQR)	4 (3–6)	5 (4–8)	0.015

Virus-positive children were significantly younger than virus-negative children (37.1 ± 42.2 vs 54.9 ± 48.0 months; $p = 0.009$). Virus-positive children also had significantly higher rates of fever, shortness of breath, cough, expectoration, and rhinorrhea, and a longer duration of illness ($p = 0.015$). Sex distribution did not differ significantly between the groups ($p = 0.76$). For categorical comparisons with adequate expected counts, continuity-corrected (Yates') chi-square tests were used; for cough, where the minimum expected count was 4.80, Fisher's exact test was used. The direction and statistical significance of the symptom associations remained consistent with the patient-level raw data.

5. Discussion

This overall etiological split can be corroborated with the broader literature on Indian paediatric respiratory infection, with *Streptococcus pneumoniae* being the most commonly isolated bacterium in the nasopharynx in most previous Indian studies, and *Klebsiella pneumoniae* and other Gram negative organisms increasing in more recent Indian studies (Mathew et al., 2015; Vikhe et al., 2024) which is reflected in this cohort, with *S. pneumoniae* (43.75%) and *K. pneumoniae* (28.13%) being the two most common bacterial isolates from the nasopharynx. On the other hand, the most prevalent pathogens in a large cohort from Eastern Uttar Pradesh were parainfluenza virus, adenovirus and RSV (Deval et al., 2025), and RSV, rhinovirus and adenovirus were the three most frequently identified viruses in children under five years old that caused severe pneumonia mortality worldwide (FIRS, 2025). The seasonal analysis (Table 2) revealed the presence of the pathogens in the season predominantly to winter, which is in line with several regional and international reports.

A large Saudi Arabian cohort showed that winter is the season for the highest levels of viral positivity, with this being largely due to RSV (Albogami et al., 2018), and national hospital surveillance data from the United States for the 2024–2025 season also confirmed that winter months have the highest number of RSV-, influenza-, and COVID-19-associated paediatric hospitalizations (Lee et al., 2026). The seasonal effect was statistically significant for 'any pathogen' detection ($p = 0.002$) and 'virus only' detection ($p = 0.039$), but not for 'bacteria only' (Fisher–Freeman–Halton exact $p = 0.836$) or 'mixed infection' detection (exact $p = 0.486$), suggesting that the winter effect in this dataset was largely due to virus detection, not bacteria detection. Pathogen-specific seasonal trends, however, do not hold for all pathogens or years: For example, the 2023–2024 multicentre surveillance in China indicated that the detection of RSV has shifted from spring–summer in 2023 to summer–autumn in 2024, whereas that of human rhinovirus consistently peaked in autumn, suggesting pathogen–seasonal variation between years and regions and should be interpreted with caution based on the specific climatic trends in North India. Individual viruses (Table 3) were each found in higher concentration in winter, which was broadly similar to that reported for peak concentration of RSV in winter from Saudi Arabia (Albogami et al., 2018) and that reported of multiplex-PCR viral positivity among young children from Eastern Uttar Pradesh (Deval et al., 2025). The number of cases of influenza B or dual-virus categories (RSV + rhinovirus, RSV + adenovirus) was too small to make definitive statements on their seasonal behaviour, and a formal significance test was not conducted on the individual-virus-by-season table for this reason. The findings presented in Tables 4 and 5 can be compared to recent clinical cohorts of paediatric community-acquired pneumonia regarding clinical phenotype. A Vietnamese cohort of children with confirmed community-acquired pneumonia (CAP) showed that the disease is most common in children aged 12 months to five years, and associated with cough, fever, breathlessness (tachypnoea), and crackles (Quynh et al., 2025), which were used in comparisons of symptom patterns for this study. In the present dataset, pathogen-positive and pathogen-negative children did not differ significantly in age (48.4 vs 51.1 months; $p = 0.466$), although pathogen-positive children had significantly higher rates of fever, shortness of breath, cough, expectoration, and rhinorrhea and a longer duration of illness. In contrast, virus-positive children were significantly younger than virus-negative children (37.1 vs 54.9 months; $p = 0.009$) and also showed higher frequencies of the same respiratory and upper-airway symptoms and a longer illness duration.

Thus, the patient-level analysis supports a significant age association specifically for viral detection, but not for overall pathogen detection. Accordingly, evidence from regional studies describing greater susceptibility of younger children should be interpreted here as supporting the viral-detection pattern rather than as evidence that younger age predicts detection of any respiratory pathogen. This more specific interpretation is consistent with regional surveillance emphasizing the vulnerability of younger children to respiratory viral infections (Deval et al., 2025; Mishra et al., 2025).

6. Limitations

There are several limitations to the study that need to be taken into consideration when interpreting the findings. First, its retrospective, single-center, and hospital-based design may restrict the generalizability of the conclusions to the community-level and outpatient populations, and may also include referral bias. While the number of 210 was sufficient for most statistical comparisons, low cell counts were noted in some of the tables of individual pathogens and seasons (Table 3) and for this reason the table was presented descriptively instead of a single omnibus test of significance. Limited sensitivity of the diagnosis was also due to the specific viral and bacterial panel tested, with pathogens not included in the panel (*Mycoplasma pneumoniae*, human metapneumovirus), and other respiratory viruses and other fungal pathogens not tested for. Thus there may be some pathogen-negative cases that were simply due to diagnostic challenges. Lastly, this was an observational study, therefore the associations between pathogen category and clinical phenotype identified cannot be used to infer causality.

7. Conclusion

This cohort indicates a significant winter predominance in the detection of respiratory pathogens in hospitalised children in North India, with the majority of pathogen detection being viral. Pathogen-positive children had a more symptomatic clinical presentation, with higher rates of fever, shortness of breath, cough, expectoration, and rhinorrhea and longer illness duration, but their age did not differ significantly from pathogen-negative children. Virus-positive children, however, were significantly younger than virus-negative children and showed a similarly more symptomatic clinical profile. The most frequently detected virus was RSV and was found in higher numbers, along with rhinovirus and adenovirus, during winter. These patterns support season-specific diagnostic preparedness, bed and oxygen-supply readiness, and age-stratified viral surveillance in paediatric respiratory illness in North India.

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All authors declare that this research article is original and has not been published elsewhere in any form or language (partially or in full).

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Not applicable

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Declaration of Generative AI and AI-assisted technologies in the writing process:

During the preparation of this work, the authors had not used any AI-assisted technologies. The authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Data transparency

All authors agree that all data, materials as well as software application has supported their published claims and complied with field standards.

Author contributions

Dr. Sonalika Singh, Dr. Ankur Goyal and Dr. Neeraj Kumar, have contributed to the study conception and design for this research work. Material's preparation, data collection and analysis were performed by scholar, Mr. Vinay Verma, Ms. Neha K. Mani and Dr. Ashish Singh. The first draft of the manuscript was written by Mr. Vinay Verma. Dr. Sonalika Singh and Dr. Ankur Goyal, have thoroughly reviewed and approved the final manuscript.

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