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Pattern and risk factors of acute respiratory infections in children under five years: A hospital-based cross-sectional observational study.

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Abstract

Background:

Acute respiratory infections (ARIs) remain one of the leading causes of morbidity and hospitalization among children under five years, particularly in low- and middle-income countries. Identifying demographic, environmental, and nutritional risk factors is essential to guide preventive strategies and optimize health outcomes.

Objectives:

To determine the clinical pattern and assess the key risk factors associated with acute respiratory infections in children under five years of age attending a tertiary care hospital.

Methods:

A hospital-based observational study was conducted among 100 children aged below five years clinically diagnosed with ARI. Data were collected using a structured proforma covering demographic details, clinical presentation, nutritional and immunization status, and environmental conditions. Statistical analysis was performed using descriptive measures and percentage distribution.

Results:

The majority of cases occurred in the 1–3-year age group (46%), with males (58%) slightly predominating. Upper respiratory tract infections (64%) were more frequent than lower respiratory infections (36%). The most common presenting symptoms were cough (94%), fever (86%), and nasal discharge (72%). Undernutrition was identified in 42% of children, and 58% belonged to the lower socioeconomic class. Major risk factors included indoor air pollution (68%), overcrowding (52%), passive smoking (36%), and lack of exclusive breastfeeding (46%). Incomplete immunization was observed in 28%, and low birth weight (<2.5 kg) in 34%. ARI incidence peaked during the monsoon and winter months (62%). The mean hospital stay was 4.6 ± 2.1 days, with full recovery in 92% of cases and no mortality reported.

Conclusion:

Acute respiratory infections in children were predominantly associated with modifiable risk factors such as undernutrition, indoor air pollution, overcrowding, and incomplete immunization. Most cases were mild and preventable through early intervention.

Recommendations:

Community-level interventions such as promoting exclusive breastfeeding, complete immunization, improving ventilation, discouraging tobacco exposure, and reducing indoor air pollution are essential to minimize ARI burden.

Keywords: *Acute respiratory infection, under-five children, risk factors, indoor air pollution, breastfeeding, socioeconomic status*
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Introduction

Acute respiratory infections (ARIs) remain one of the most pressing public health challenges in developing countries, particularly among children under five years of age. Globally, they are responsible for an estimated 20–25% of all childhood deaths, with the greatest burden occurring in low- and middle-income nations where health resources and preventive interventions are limited [1]. Despite substantial advances in immunization coverage and child health programs, India continues to report high ARI-associated morbidity and hospitalization rates, largely influenced by environmental pollution, poor nutrition, and socioeconomic disparities [2,3].

Children below five years are biologically more susceptible to ARIs due to immature immune mechanisms, narrow airways, and frequent exposure to infectious pathogens in overcrowded living environments [4]. The disease spectrum ranges from mild upper respiratory infections such as rhinitis, pharyngitis, and otitis media to severe lower respiratory illnesses, including bronchiolitis and pneumonia, which often necessitate inpatient management [5].

A multitude of factors contribute to the persistence and recurrence of ARIs, including undernutrition, incomplete immunization, indoor air pollution, exposure to tobacco smoke, and poor housing conditions. The interplay of these determinants not only increases the risk of infection but also complicates disease outcomes and recovery. Seasonal variations, particularly during the monsoon and early winter months, have been shown to exacerbate transmission dynamics due to high humidity and temperature fluctuations, further elevating infection rates in vulnerable populations.

Recognizing epidemiological patterns and associated risk factors is essential for informing effective preventive, educational, and policy interventions. The present study was undertaken to assess the clinical pattern and major demographic, nutritional, and environmental determinants of acute respiratory infections among children under five years attending a tertiary care hospital in Khammam, Telangana.

Methodology

Study Design and Setting

This was a hospital-based cross-sectional observational study conducted in the Department of Pediatrics, Government General Hospital, Khammam, Telangana, India. The hospital is a tertiary-care referral center serving the urban and rural populations of the Khammam district and adjoining regions. The study was carried out over a one-year period from February 2024 to January 2025.

Study Population

The study included children aged below five years who presented to the pediatric outpatient department or were admitted with clinical features suggestive of acute respiratory infection (ARI). The diagnosis was made based on history, physical examination, and relevant investigations as per the WHO and Integrated Management of Neonatal and Childhood Illness (IMNCI) guidelines.

Sample Size and Sampling Technique

A total of 100 children fulfilling the inclusion criteria were enrolled using consecutive sampling until the desired sample size was achieved. Informed consent was obtained from parents or guardians before participation.

Inclusion Criteria

Children aged 0–5 years diagnosed with acute upper or lower respiratory tract infection (duration <14 days).
Parents or guardians who provided informed consent.

Exclusion Criteria

Children with chronic respiratory diseases (asthma, tuberculosis, bronchiectasis).
Those with congenital heart disease, immunodeficiency, or severe malformations affecting the respiratory system.

Data Collection Procedure

Data were collected using a pretested structured proforma, which included:

Demographic details – age, gender, and residence.
Clinical data – presenting symptoms, type of ARI (URTI/LRTI), and clinical course.
Nutritional and immunization status – assessed according to WHO growth charts and the National Immunization Schedule.
Environmental and socioeconomic parameters – type of housing, ventilation, fuel used for cooking, overcrowding, and parental smoking habits (based on the Modified Kuppuswamy scale).
Birth history – including birth weight and breastfeeding practices.

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Bias Control:

Selection bias was minimized by enrolling consecutive eligible children presenting with acute respiratory infections during the study period. Information bias was reduced by using a pretested structured proforma and standardized WHO/IMNCI diagnostic criteria. Measurement bias was limited by uniform clinical assessment performed by trained pediatricians. Recall bias related to feeding and environmental exposure was minimized by cross-verifying caregiver responses with medical records wherever possible.

Statistical Analysis

All collected data were entered into Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Results were expressed as frequency and percentage for categorical variables and mean ± standard deviation for continuous variables. Associations between categorical variables were evaluated using the Chi-square test, with a p-value < 0.05 considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of Government Medical College and General Hospital, Khammam, before initiation of the study. Confidentiality of participants was maintained throughout, and all procedures adhered to the ethical principles of the Declaration of Helsinki.

Results

A total of 118 children under five years presenting with symptoms suggestive of acute respiratory infection (ARI) were screened for eligibility at the Department of Pediatrics, Government General Hospital, Khammam. Of these, 12 children were excluded; six had chronic respiratory or cardiac conditions (asthma, bronchiectasis, congenital heart disease), three had immunodeficiency disorders, and three parents declined consent. The remaining 106 eligible participants were enrolled, of whom six were excluded due to incomplete records or early discharge against medical advice. Finally, 100 children met all inclusion criteria and were analyzed for demographic distribution, clinical presentation, and associated risk factors (Figure 1).

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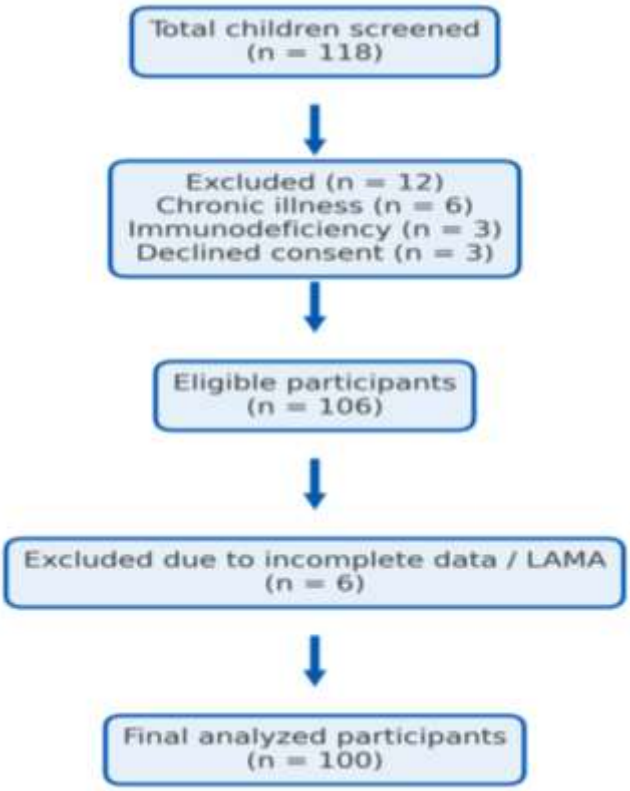

Figure 1. Participant Flow Diagram

A total of 100 children under five years of age diagnosed with acute respiratory infections (ARIs) were included in the present hospital-based observational study. The demographic characteristics of the study participants are summarized in **Table 1**. The majority of affected children belonged to the 1–3-year age group (46%), followed by those below 1 year (28%) and 3–5 years (26%). Males constituted 58% of the study population, resulting in a male-to-female ratio of 1.4:1. The mean age of the cohort was 2.8 ± 1.3 years. Most children were from rural areas (60%), while 40% resided in urban settings.

Table 1. Demographic Characteristics of Study Population (n = 100)

Parameter	Category	Number (n)	Percentage (%)
Age group (years)	<1 year	28	28.0
	1–3 years	46	46.0
	3–5 years	26	26.0
Gender	Male	58	58.0
	Female	42	42.0
Mean age (years)	—	2.8 ± 1.3	—
Residence	Urban	40	40.0
	Rural	60	60.0

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The distribution of clinical features and patterns of respiratory involvement is presented in **Table 2**. The predominant symptoms were cough (94%), fever (86%), and nasal discharge (72%). Breathlessness and wheezing were reported in 38% and 26% of cases, respectively. Based on clinical and radiological assessment, upper respiratory tract infections (URTI) constituted the majority (64%), while lower respiratory tract infections (LRTI) accounted for 36% of cases. Among LRTI, pneumonia (22%) was the most frequent diagnosis, followed by bronchiolitis (10%) and laryngotracheobronchitis (4%).

Table 2. Clinical Pattern of Acute Respiratory Infections

Clinical Feature	Number (n)	Percentage (%)
Cough	94	94.0
Fever	86	86.0
Nasal discharge	72	72.0
Breathlessness	38	38.0
Wheezing	26	26.0
Type of ARI		
Upper respiratory tract infection (URTI)	64	64.0
Lower respiratory tract infection (LRTI)	36	36.0
Pneumonia	22	22.0
Bronchiolitis	10	10.0
Laryngotracheobronchitis	4	4.0

Nutritional, socioeconomic, and environmental determinants of ARI are detailed in **Table 3**. Forty-two percent of children were undernourished according to the WHO growth standards. More than half of the participants (58%) belonged to the lower socioeconomic class, while 30% were from the lower-middle class. Indoor air pollution was a prominent contributor, reported in 68% of households—mainly due to biomass fuel usage and poor ventilation. Passive exposure to tobacco smoke was noted in 36% of cases, and overcrowding (≥3 persons per room) was observed in 52% of families.

Table 3. Distribution According to Nutritional, Socioeconomic, and Environmental Factors

Risk Factor	Category	Number (n)	Percentage (%)
Nutritional status	Normal	58	58.0
	Undernourished	42	42.0
Socioeconomic status	Upper middle	12	12.0
	Lower middle	30	30.0
	Lower	58	58.0
Indoor air pollution	Present	68	68.0
	Absent	32	32.0
Passive smoking exposure	Yes	36	36.0
	No	64	64.0
Overcrowding	Yes	52	52.0
	No	48	48.0

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Association between risk factors and type of ARI:

Statistical analysis using the Chi-square test demonstrated a significant association between lower respiratory tract infections and undernutrition ($\chi^2 = 6.84$, $p = 0.009$), indoor air pollution ($\chi^2 = 8.12$, $p = 0.004$), overcrowding ($\chi^2 = 5.96$, $p = 0.015$), and incomplete immunization ($\chi^2 = 4.87$, $p = 0.027$). Passive smoking exposure was also significantly associated with LRTI ($\chi^2 = 4.31$, $p = 0.038$). No statistically significant association was observed between gender and type of ARI ($p > 0.05$).

Additional risk factors and outcome profiles are shown in **Table 4**. Nearly half of the children (46%) were not exclusively breastfed for the first six months. Low birth weight (<2.5 kg) was found in 34% of participants, and incomplete immunization status was documented in 28%. Seasonal variation revealed a higher occurrence of ARIs during the monsoon and early winter months (July–December), accounting for 62% of total cases. The mean duration of hospital stay was 4.6 ± 2.1 days. Most patients (92%) recovered completely, while 8% required prolonged hospitalization due to complications such as pneumonia with respiratory distress. No mortality was reported in the present series.

Table 4. Other Risk Factors and Outcome Profile

Parameter	Category	Number (n)	Percentage (%)
Exclusive breastfeeding (first 6 months)	Yes	54	54.0
	No	46	46.0
Birth weight	Normal (≥2.5 kg)	66	66.0
	Low (<2.5 kg)	34	34.0
Immunization status	Complete	72	72.0
	Incomplete	28	28.0
Seasonal distribution	Monsoon–Winter (Jul–Dec)	62	62.0
	Summer–Spring (Jan–Jun)	38	38.0
Hospital stay (days)	Mean ± SD	4.6 ± 2.1	—
Outcome	Recovered	92	92.0
	Prolonged stay with complications	8	8.0
	Mortality	0	0.0

Discussion

The present hospital-based observational study explored the clinical spectrum and determinants of acute respiratory infections (ARIs) among 100 children under five years of age over one year. The findings reaffirm that ARIs continue to pose a substantial health burden in early childhood, shaped by a multifactorial interplay of demographic, nutritional, and environmental influences.

In this study, the 1–3-year age group (46%) recorded the highest incidence, followed by infants below one year (28%), suggesting that immune immaturity and increased exposure to pathogens predispose younger children to recurrent infections. Similar trends have been reported in recent Asian and global literature, where susceptibility was shown to decline progressively with advancing age [6]. The male predominance (58%) observed corresponds with previous pediatric observations indicating slightly higher infection risk in boys due to airway size differences and immunological factors [7].

Upper respiratory tract infections (URTI) were more prevalent (64%) than lower respiratory tract infections (LRTI) (36%), consistent with WHO-based epidemiological data showing URTIs as the most frequent cause of childhood morbidity worldwide [12]. Among LRTIs, pneumonia (22%) was the leading diagnosis, aligning with global surveillance reports that rank pneumonia as the foremost

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cause of respiratory hospitalization and under-five mortality [12].

Undernutrition (42%) emerged as a significant determinant of ARI occurrence, underscoring the established link between malnutrition and impaired immune competence. Previous studies have demonstrated that nutritional deprivation, coupled with suboptimal feeding practices, considerably elevates susceptibility to recurrent respiratory infections in infants [6]. Moreover, exclusive breastfeeding during the first six months has been shown to offer strong protective effects against ARIs, reducing both frequency and severity through passive immunologic mechanisms [7]. The 46% of non-exclusively breastfed children in this study thus reflect a preventable risk factor.

Environmental determinants played a substantial role; indoor air pollution (68%), overcrowding (52%), and passive smoking (36%) were major contributors. These findings are concordant with studies from South Asia reporting that biomass fuel exposure, poor ventilation, and crowded dwellings markedly increase ARI risk [8,9]. Inadequate housing structure and poor indoor environmental quality have been identified as strong predictors of respiratory infections in children, supporting the relevance of the present findings [9].

A pronounced seasonal variation was evident, with a higher incidence during the monsoon and early winter months (July–December). This observation aligns with reports highlighting that fluctuating humidity and temperature enhance viral persistence and transmission in tropical climates [11]. The identification of incomplete immunization (28%) as a contributing factor reinforces the need for continuous adherence to national vaccination schedules, as emphasized in population-based cross-sectional analyses on ARI management practices in India [10].

Encouragingly, most children (92%) recovered completely, while only 8% required prolonged hospitalization, reflecting the efficacy of early diagnosis and IMNCI-guided management. Similar favorable outcomes have been reported in recent hospital-based surveillance studies when standardized pediatric treatment protocols were implemented [11].

Generalizability

The findings of this study are generalizable to similar semi-urban and rural populations in India, where environmental, nutritional, and socioeconomic determinants closely resemble those observed in the present cohort. The identified risk factors, such as indoor air pollution, overcrowding, undernutrition, incomplete immunization, and inadequate breastfeeding, are widely prevalent in comparable community settings. Hence, the results provide a realistic reflection of the burden and modifiable determinants of acute respiratory infections among children and can effectively guide preventive, educational, and policy interventions at the primary healthcare level.

Conclusion

Acute respiratory infections continue to impose a substantial health burden among children under five years, particularly in low-resource settings. The present study demonstrated that factors such as young age, undernutrition, indoor air pollution, overcrowding, passive smoking, and incomplete immunization significantly contribute to ARI occurrence. Most infections were mild and preventable through community-based measures. Strengthening exclusive breastfeeding practices, vaccination coverage, maternal education, and environmental hygiene can markedly reduce morbidity. The findings emphasize the need for integrated preventive strategies and health education programs targeting families and caregivers to minimize ARI incidence and improve child survival outcomes in similar socio-demographic populations.

Limitations

The study was conducted at a single tertiary-care center with a relatively small sample size of 100 participants, limiting the external validity of the findings. Microbiological confirmation of viral or bacterial pathogens was not performed due to logistical and cost constraints, restricting etiological correlation. The cross-sectional design captured data at one point in time, precluding assessment of recurrence or long-term outcomes. Despite these constraints, the study provides valuable insight into the prevalent patterns and modifiable risk factors influencing acute respiratory infections among children.

Recommendations

Effective control of acute respiratory infections in children requires a multi-pronged preventive approach. Health authorities should prioritize promotion of exclusive breastfeeding, complete immunization, and nutritional supplementation through community outreach programs. Reducing indoor air pollution by encouraging the use of clean cooking fuels and improving household ventilation is

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essential. Awareness campaigns targeting parents should emphasize avoiding passive smoking, minimizing overcrowding, and seeking early medical care. Strengthening Integrated Management of Childhood Illness (IMNCI) protocols at the primary-care level and continuous training of healthcare workers will further enhance early diagnosis, rational antibiotic use, and prevention of recurrent infections.

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Abbreviations
ARI – Acute Respiratory Infection
URTI – Upper Respiratory Tract Infection
LRTI – Lower Respiratory Tract Infection
WHO – World Health Organization
IMNCI – Integrated Management of Neonatal and Childhood Illness
GGH – Government General Hospital
SD – Standard Deviation
SPSS – Statistical Package for the Social Sciences
IEC – Institutional Ethics Committee
LBW – Low Birth Weight
OPD – Outpatient Department
ICMR – Indian Council of Medical Research
SE – Socioeconomic
IMR – Infant Mortality Rate

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Conflict of interest
The authors declare no conflict of interest.

Author contributions
BBR-Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.

Data availability
Data available on request

Author Biography
Dr. Bunga Babu Ratnakar, MBBS, MD, DCH, is a pediatrician with over two decades of clinical and academic experience. He completed his MBBS (1989), DCH (1994), and MD (Pediatrics, 2017) from Osmania Medical College, Hyderabad. He served as Assistant Professor of Pediatrics for five years at Government Medical College, Suryapet, and subsequently at Government Medical College, Khammam. He is presently working as an Associate Professor in the Department of Pediatrics, GGH Khammam. His areas of interest include childhood respiratory infections, neonatal care, and community-based child health. Dr. Ratnakar is actively involved in undergraduate and postgraduate medical teaching and continues to contribute to pediatric research and public health initiatives. **ORCID ID:** https://orcid.org/0000-0002-0921-6241

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Dr. Guguloth Latha, MBBS, MD, is currently serving as Assistant Professor in the Department of Pediatrics at Government Medical College, Khammam, Telangana. She has a strong background in child health and clinical pediatrics. She is actively involved in undergraduate teaching, pediatric patient care, and academic research. Her key areas of interest include neonatal medicine, pediatric infectious diseases, and growth and nutrition disorders. Dr. Latha is committed to advancing child health through evidence-based practice, compassionate care, and continued medical education.

Dr. Bunga Harshita is currently an MBBS intern at Osmania Medical College, Hyderabad, Telangana. During her medical training, she has demonstrated a keen interest in

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clinical pediatrics and preventive child health. She has actively participated in academic discussions, clinical case presentations, and community health programs. Her areas of academic interest include pediatric infectious diseases, adolescent health, and nutrition. Dr. Harshita aspires to pursue postgraduate training in pediatrics and contribute to improving healthcare outcomes for children through evidence-based clinical practice and research.

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