Original Research Article

Prevalence and Risk Factors of Respiratory Tract Infections Among Children Under Five Years in a Tertiary Care Hospital

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Abstract

Background: Respiratory tract infections (RTIs) are a leading cause of morbidity and mortality among children under five years, particularly in low- and middle-income countries. Understanding the prevalence, risk factors, and impact of RTIs is crucial for developing effective prevention and management strategies. **Objective:** To determine the prevalence and risk factors of RTIs among children under five years in a tertiary care hospital, examining associations with demographic, environmental, and clinical variables. **Methods:** A hospital-based cross-sectional study was conducted in the Pediatric Outpatient and Inpatient Departments of [Hospital Name] from July 2018 to December 2018. A total of 286 children aged 0–5 years presenting with RTI symptoms were included. Data were collected using structured questionnaires and medical record reviews, capturing demographic, clinical, and environmental factors. Laboratory investigations included nasopharyngeal swabs, blood tests (CRP, procalcitonin), and chest X-rays. Statistical analyses included chi-square tests for categorical variables, independent t-tests for continuous variables, and multivariate logistic regression to identify independent risk factors. **Results:** The prevalence of RTIs was 79.3% (227/286), with 117 (40.9%) diagnosed with lower respiratory tract infections (LRTIs) and 110 (38.5%) with upper respiratory tract infections (URTIs). The mean age of affected children was 30.2 months. Vaccination status showed a borderline significant association with RTI occurrence ($p = 0.086$), while duration of symptoms was significantly longer in RTI cases ($p = 0.0095$). Parental smoking ($p = 0.17$), household crowding ($p = 1.0$), and exposure to biomass fuel ($p = 0.58$) were not significantly associated with RTI prevalence. Logistic regression did not identify any independent risk factors. **Conclusion:** RTIs are highly prevalent among children under five, with vaccination status being a potential protective factor. The longer symptom duration in RTI cases suggests the need for early diagnosis and management. Other environmental and demographic variables did not show significant associations. Further studies with larger samples and detailed pathogen analysis are recommended to refine RTI risk assessment and prevention strategies.

Keywords: Respiratory Tract Infections, Pediatrics, Risk Factors, Epidemiology

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INTRODUCTION

Respiratory tract infections (RTIs) are among the leading causes of morbidity and mortality in children under five years of age, particularly in low- and middle-income countries. These infections encompass a range of illnesses, from mild upper respiratory tract infections to severe lower respiratory tract infections, such as pneumonia and bronchiolitis. Understanding the epidemiology, risk factors, and impact of RTIs in this vulnerable population is crucial for developing effective prevention and management strategies.

Respiratory tract infections (RTIs) have historically posed a significant health burden among children under five, both globally and in India.[2] Prior to 2018, RTIs were among the leading causes of morbidity and mortality in young

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children worldwide. In 2016, it was estimated that there were approximately 5.1 million hospital admissions due to lower respiratory infections among children under five.[3]
Several factors increase the susceptibility of children under five to respiratory tract infections (RTIs). Exposure to indoor air pollution, such as smoke from biomass fuels used for cooking and heating, has been associated with a higher incidence of RTIs.[4] A study in Ethiopia found that children exposed to wood smoke had increased odds of developing acute respiratory infections (ARIs) . Similarly, passive smoking or exposure to second-hand smoke has been linked to a higher incidence of RTIs, with children living with smokers having increased odds of developing ARIs.[5] Low socioeconomic status and limited maternal education have been consistently linked to a higher prevalence of RTIs among children.[6] Malnutrition is a critical determinant of RTI susceptibility, as children with poor nutritional status have compromised immune systems, making them more vulnerable to infections.[7] Younger age has been associated with a higher risk of RTIs, particularly in infants under 12 months due to their immature immune systems.[8] Conversely, breastfeeding has been shown to have a protective effect against RTIs, with breastfed children having a lower risk of exhibiting ARI symptoms . Seasonal factors also influence the prevalence of RTIs, with variations observed during different climatic conditions, affecting the transmission dynamics of respiratory pathogens. Additionally, immunocompromised states, such as HIV infection, have been linked to an increased risk of RTIs, emphasizing the need for targeted interventions in this vulnerable population.[9]

In 2018, respiratory tract infections (RTIs), particularly pneumonia, remained leading causes of mortality among children under five years old. Globally, pneumonia claimed the lives of over 700,000 children in this age group, underscoring its significant impact on child health
Given the high burden of RTIs and the multitude of associated risk factors, there is a pressing need for comprehensive studies that explore these determinants in specific contexts. Identifying modifiable risk factors can inform targeted interventions to reduce the incidence and severity of RTIs among children under five. This study aims to investigate the prevalence of RTIs and associated risk factors among children under five in a tertiary care hospital setting, providing insights that could contribute to improved child health outcomes.

METHODOLOGY

Study Design and Setting

This hospital-based cross-sectional study was conducted at the Paediatric Outpatient and Inpatient Departments of SVS Medical College & Hospital, Mahabubnagar, a tertiary care hospital. The study was carried out over a six-month period from July 2018 to December 2018.

Study Population

The study population comprised children aged 0 to 5 years who presented with respiratory symptoms suggestive of respiratory tract infections (RTIs). A total of 286 children who met the eligibility criteria were enrolled in the study.

Ethical Considerations

This study received Institutional Ethics Committee (IEC) approval and written informed consent was obtained from parents or legal guardians before participation. Confidentiality was ensured by coding patient data and restricting access to authorized personnel. All data were used solely for research purposes in compliance with ethical guidelines. Children diagnosed with RTIs received standard medical care, with no participant denied treatment due to study involvement.

Eligibility Criteria

Inclusion Criteria:

Children aged between 0 and 5 years were eligible for inclusion in the study. The selection was based on clinical presentation and physician assessment confirming the diagnosis of a respiratory tract infection (RTI). This ensured that only children with symptoms indicative of an RTI were included in the study population.

Exclusion Criteria:

Children with pre-existing chronic respiratory conditions, such as cystic fibrosis or bronchopulmonary dysplasia, were excluded from the study. These conditions can significantly alter respiratory function and predispose children to frequent infections, which could confound the study findings. Similarly, children with known congenital respiratory anomalies or immunodeficiency disorders were excluded, as these conditions could independently influence susceptibility to RTIs. Cases with incomplete medical records or those who were lost to follow-up during data collection were also excluded to ensure the reliability and completeness of the dataset.

Sample Size and Sampling Technique

The study included 286 children, with the sample size determined based on feasibility and the expected number of RTI cases presenting at the hospital during the study period. A systematic random sampling method was used to ensure an unbiased selection of participants. Children meeting the inclusion criteria were selected from both the outpatient and inpatient pediatric departments, allowing for a comprehensive representation of cases across varying levels of illness severity.

Data Collection

Data collection was carried out using a structured questionnaire and medical records review. The questionnaire was designed to capture demographic details, clinical presentation, environmental factors, and laboratory findings. Trained research assistants and attending pediatricians administered the questionnaire and performed clinical assessments.

Demographic and Socioeconomic Data Collection

Demographic and socioeconomic data were collected to assess potential risk factors associated with respiratory tract infections (RTIs) among children. Information such as age, sex, weight, and height was recorded to evaluate growth patterns and overall health status, with nutritional status assessed based on WHO growth charts. Birth history, including details of preterm birth and low birth weight, was documented to identify children who may have a higher risk of developing infections due to compromised immunity.

Vaccination status was verified according to the national immunization schedule to determine whether incomplete immunization influenced RTI occurrence. Additionally, the socioeconomic status of the family was evaluated using the Kuppuswamy scale, which considers factors such as parental education, occupation, and income. Environmental exposures, including parental smoking, use of biomass fuel for cooking, and household crowding, were assessed, as these factors have been linked to increased susceptibility to respiratory infections in children.

Clinical Data Collection

Clinical data were obtained through a combination of parental interviews and physician assessments. Symptoms at presentation were documented, including fever, cough, nasal congestion, difficulty breathing, wheezing, and stridor. The duration of symptoms before hospital presentation was recorded to understand the severity and progression of the illness.

A thorough physical examination was conducted for each child, including temperature measurement, respiratory rate assessment, and auscultation of the chest to detect abnormal lung sounds such as wheezing or crackles. Children were categorized into upper respiratory tract infections (URTIs) and lower respiratory tract infections (LRTIs) based on clinical findings. The severity of RTI was classified as mild, moderate, or severe using the WHO Integrated Management of Childhood Illness (IMCI) guidelines, ensuring a standardized approach to illness classification.

Laboratory Investigations

Laboratory investigations were performed to confirm RTI diagnosis and identify potential causative pathogens. Nasopharyngeal and throat swabs were collected from symptomatic children using sterile swabs and analyzed using polymerase chain reaction (PCR) and culture methods to detect viral and bacterial infections. Blood samples were obtained to measure complete blood count (CBC), C-reactive protein (CRP), and procalcitonin (PCT) levels, which help differentiate bacterial from viral infections and assess the severity of inflammation.

For children with productive cough or requiring mechanical ventilation, sputum and tracheal aspirates were collected for Gram staining, bacterial culture, and antimicrobial sensitivity testing. In cases where pneumonia was suspected, chest X-rays were performed to detect pulmonary infiltrates, consolidation, or pleural effusion, aiding in the confirmation of lower respiratory tract infections.

Treatment and Outcomes

The type of medical intervention received by each child was documented, including antibiotic therapy, nebulization, oxygen therapy, and hospital admission. The duration of hospitalization and discharge outcomes were recorded to evaluate disease severity and recovery rates.

A follow-up assessment was conducted one week post-discharge to monitor recovery and detect any complications or recurrence of symptoms. This follow-up period helped in determining the effectiveness of treatment and identifying any lingering effects of the infection, contributing to a comprehensive understanding of RTI management and outcomes in the pediatric population.

Data Management and Analysis

All collected data were systematically recorded and managed using Microsoft Excel before being transferred for statistical analysis in SPSS version 25.0. The data underwent quality checks to ensure completeness and accuracy before analysis.

In the descriptive statistical analysis, categorical variables such as gender, symptom distribution, and vaccination status were summarized as percentages and frequencies, allowing for a clear overview of participant characteristics. Continuous variables, including age, duration of symptoms, and laboratory parameters, were expressed as means and standard deviations (SD) to provide insight into their distribution within the study population.

For inferential statistical analysis, chi-square tests were conducted to determine associations between RTI occurrence and categorical risk factors, such as parental smoking and vaccination status. Independent t-tests were used to compare continuous variables like age and duration of symptoms between children diagnosed with RTIs and those without RTIs. To identify independent risk factors for RTIs, a multivariate logistic regression analysis was performed, adjusting for potential confounders such as age, gender, socioeconomic status, and nutritional status. The results of the logistic regression were reported as adjusted odds ratios (AOR) with 95% confidence intervals (CI), allowing for a robust interpretation of risk factors associated with RTI occurrence.

RESULTS

Figure 1 provides an overview of key demographic and clinical characteristics related to respiratory tract infections (RTIs) among children under five years in a tertiary care hospital. Gender distribution shows a slightly higher proportion of females (156) compared to males (130). RTI diagnosis classification indicates that 117 children had lower respiratory tract infections (LRTI), 110 had upper respiratory tract infections (URTI), and 59 had no RTI.

Regarding vaccination status, the majority of children were fully vaccinated (198), whereas 57 were partially vaccinated, and 31 were not vaccinated. Parental smoking was reported in 79 cases, while 207 children had no exposure to parental smoking. Household crowding (>5 members) was present in 111 cases, compared to 175 children from less crowded households. Exposure to biomass fuel was noted in 86 children, whereas 200 children did not have such exposure.

Hospital admissions were observed in 141 cases, while 145 children were managed without admission. Antibiotic use was reported in 199 cases, highlighting a high rate of antimicrobial therapy among the affected population.

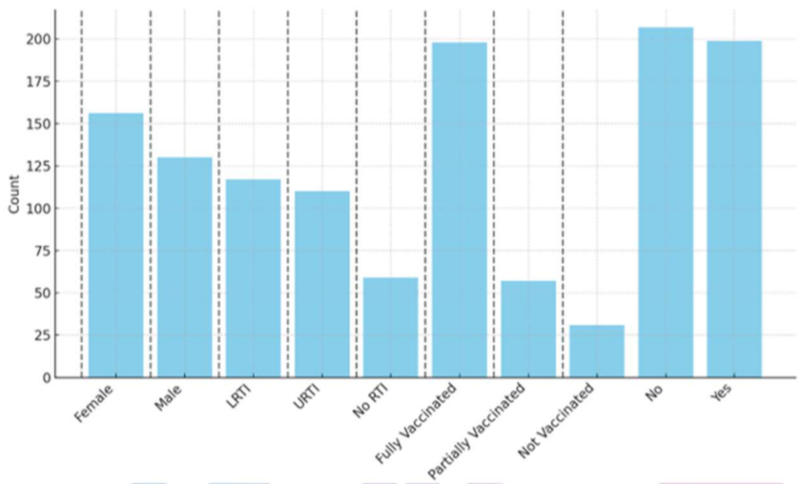

Figure 1: Distribution of Demographic, Clinical, and Environmental Factors

Table 1 presents the descriptive statistics for continuous variables among the study population. The mean age of the children was 30.2 months (approximately 2.5 years), with a range from 1 to 59 months, indicating a diverse sample covering infancy and early childhood. The mean weight was 11.5 kg, and the mean height was 75.9 cm, reflecting normal growth trends within the studied age range.

The duration of symptoms showed significant variation, with an average of 7.36 days and a standard deviation of 3.72 days, suggesting a broad range of illness severity. The respiratory rate had a mean of 40.3 breaths per minute, aligning with the normal physiological range for young children, though some cases recorded values as high as 59 breaths per minute, indicating possible respiratory distress. Inflammatory markers also showed a wide range of values. C-reactive protein (CRP) levels averaged 25.56 mg/L, with values reaching up to 49.82 mg/L, reflecting varying levels of systemic inflammation. Procalcitonin levels had a mean of 4.71 ng/mL, with a standard deviation of 2.88 ng/mL, highlighting potential differences in bacterial versus viral infection responses among children.

Table 1: Continuous Variable Summary

	count	mean	std	min	25%	50%	75%	max
Age_months	286	30.1958	17.29913	1	15	30.5	44	59
Weight (kg)	286	11.50378	5.319634	2.69	7.075	11.63	16.1825	20
Height (cm)	286	75.87378	18.25578	45.3	58.625	75	91.475	109.8
Duration of Symptoms (days)	286	7.36014	3.719982	1	4	8	11	13
Respiratory Rate (breaths/min)	286	40.29371	11.26823	20	31	40.5	49.75	59
CRP_mgL	286	25.56245	14.33977	0.26	12.725	27.15	38.0125	49.82
Procalcitonin_ngmL	286	4.708881	2.880093	0.02	2.235	4.46	7.25	9.98

Chi-square tests were conducted to assess the association between categorical risk factors and the presence of respiratory tract infections (RTIs) (Table 2). Gender was not significantly associated with RTI occurrence (p = 0.28), indicating no difference in RTI prevalence between males and females. Vaccination status approached statistical significance (p = 0.086), suggesting that a relationship might exist between vaccination coverage and RTI occurrence, though further investigation with a larger sample is needed.

Parental smoking did not show a significant association with RTI presence (p = 0.17), suggesting that passive smoking exposure may not have a strong influence on RTI risk in this study population. Similarly, household crowding (p = 1.0) and exposure to biomass fuel (p = 0.58) did not demonstrate significant relationships with RTI occurrence.

Table 2: Chi-square Test Results

	Chi2	p-value
Gender	1.167554	0.279904
Vaccination Status	4.896564	0.086442
Parental Smoking	1.886686	0.169576
Household Crowding (>5 members)	0	1
Exposure to Biomass Fuel	0.31412	0.575163

Independent t-tests were performed to compare continuous variables between children with and without RTI (Table 3). Age (p = 0.996), weight (p = 0.997), and height (p = 0.438) did not show significant differences between groups, indicating that these growth parameters were not associated with RTI occurrence.

The duration of symptoms was the only variable that showed a statistically significant difference (p = 0.009), with children diagnosed with RTI experiencing a longer duration of symptoms compared to those without RTI. This suggests that RTI cases tend to have prolonged illness, which may impact treatment decisions and healthcare burden.

Other physiological and inflammatory markers, including respiratory rate (p = 0.701), CRP levels (p = 0.667), and procalcitonin levels (p = 0.614), did not differ significantly between RTI and non-RTI cases.

Table 3: Independent t-test Results

	t-statistic	p-value
Age (months)	0.004659	0.996
Weight (kg)	0.003642	0.997
Height (cm)	-0.77629	0.438
Duration of Symptoms (days)	-2.6091	0.009
Respiratory Rate (breaths/min)	-0.38422	0.701
CRP (mg/L)	0.431002	0.666
Procalcitonin (ng/mL)	0.505404	0.613

A multivariate logistic regression analysis was conducted to identify independent risk factors for RTI occurrence, adjusting for potential confounders (Table 2). Age was not found to be a significant predictor of RTI (AOR = -0.00054, p = 0.9494), implying that RTI risk was relatively stable across the age spectrum of this study population.

Parental smoking had a negative association with RTI presence (AOR = -0.489, p = 0.118), though it did not reach statistical significance, suggesting that passive smoking may not be a primary determinant of RTI occurrence in this sample. Household crowding (AOR = 0.00547, p = 0.9855) and biomass fuel exposure (AOR = -0.2206, p = 0.4826) also showed no significant impact on RTI risk.

Inflammatory markers, including CRP levels (AOR = 0.0045, p = 0.6615) and procalcitonin levels (AOR = 0.031, p = 0.5505), were not significantly associated with RTI occurrence.

Table 4: Multivariate Logistic Regression Results

	Adjusted Odds Ratio (AOR)	Standard Error	Z-score	P-value	95% CI Lower	95% CI Upper
const	1.321796	0.491429	2.689698	0.007	0.358613	2.284979
Age_months	-0.00054	0.008558	-0.0634	0.949	-0.01732	0.016231
Parental_Smoking_Binary	-0.48907	0.313082	-1.56211	0.118	-1.1027	0.12456
Household_Crowding_Binary	0.005472	0.301929	0.018124	0.985	-0.5863	0.597242
Biomass_Fuel_Binary	-0.22062	0.314195	-0.70217	0.482	-0.83643	0.395191
CRP_mgL	0.00451	0.0103	0.437865	0.661	-0.01568	0.024697
Procalcitonin_ngmL	0.031	0.051931	0.596946	0.550	-0.07078	0.132784

DISCUSSION

Respiratory tract infections (RTIs) remain a significant cause of morbidity and mortality among children under five years of age, particularly in low- and middle-income countries. The prevalence of acute respiratory infections (ARIs) in this demographic varies across different regions and settings.[12]

Risk Factors Associated with RTIs

Understanding the risk factors associated with RTIs is crucial for developing effective prevention and intervention strategies. Several studies have identified various determinants that increase the susceptibility of children under five to RTIs.

Socioeconomic and Educational Factors

Low socioeconomic status and limited maternal education have been consistently linked to a higher prevalence of RTIs among children. In a study conducted by Tazinya *et al.*, found that children whose mothers had no formal education or only primary education were at a significantly higher risk of developing ARIs. This finding suggest that socioeconomic disparities and maternal education levels play a pivotal role in the incidence of RTIs, possibly due to differences in health literacy, access to healthcare services, and living conditions.

Environmental Factors

Environmental exposures significantly contribute to the risk of RTIs in children. Exposure to indoor air pollution, such as smoke from the use of biomass fuels for cooking and heating, has been identified as a major risk factor. A study in Ethiopia reported that children exposed to wood smoke had a higher likelihood of developing ARIs.[1 4]Similarly, Admasie *et al.*, observed that, the use of traditional cooking stoves and unclean fuel was associated with an increased risk of ALRTIs among children under five . Additionally, passive smoking or exposure to second-hand smoke has been linked to a higher incidence of RTIs. Children living with smokers had increased odds of developing ARIs.[6]

3. Nutritional Status

Malnutrition is a critical determinant of RTI susceptibility. Children with poor nutritional status have compromised immune systems, making them more vulnerable to infections. Research in SSA highlighted that malnutrition was a significant risk factor for ALRTIs among children under five . This underscores the importance of ensuring adequate nutrition to bolster immunity and reduce the incidence of RTIs.[16]

4. Age and Breastfeeding Practices

Younger age has been associated with a higher risk of RTIs. Infants, particularly those under 12 months, are more susceptible due to their immature immune systems. A study in Ethiopia found that children aged below 12 months had higher odds of developing ARIs compared to older children.[14] Conversely, breastfeeding has been shown to have a protective effect against RTIs. In a study by Wang *et al.*, it was found that breastfed children lower risk of exhibiting ARI symptoms, highlighting the benefits of breastfeeding in enhancing immunity and protecting against infections.[17]

Seasonal Variations

Seasonal factors also influence the prevalence of RTIs. The occurrence of ARI symptoms was lower during the rainy season, suggesting that climatic conditions may affect the transmission dynamics of respiratory pathogens . Understanding these patterns is essential for implementing timely public health interventions.[18]

HIV Infection

Immunocompromised states, such as HIV infection, have been linked to an increased risk of RTIs. Children with HIV had higher odds of developing ARIs, emphasizing the need for targeted interventions in this vulnerable population.[20]

Implications for Public Health and Clinical Practice

The high prevalence of RTIs and their associated risk factors necessitate targeted public health and clinical interventions. Addressing socioeconomic disparities and improving maternal education are crucial for reducing RTI burden by enhancing awareness of preventive measures, hygiene, and nutrition. Environmental interventions, such as reducing indoor air pollution from biomass fuels and minimizing passive smoke exposure, can significantly lower infection risks. Nutritional support programs aimed at providing balanced diets and educating caregivers can strengthen children's immune systems, reducing their susceptibility to RTIs. Exclusive breastfeeding for the first six months offers protective immunity, and healthcare providers should actively promote and support this practice.

Seasonal variations in RTI prevalence should inform public health strategies, including vaccination campaigns before peak seasons. Additionally, children with HIV and immunocompromised conditions are at higher risk of severe RTIs, highlighting the need for integrated healthcare approaches that combine HIV management with preventive interventions. Ensuring access to antiretroviral therapy and routine monitoring can mitigate RTI-related risks in these vulnerable populations.

Implementing Preventive Strategies

Reducing RTIs among children under five requires a multifaceted approach involving immunization, environmental modifications, nutrition, and health education. Vaccination against pathogens like Haemophilus influenzae type b (Hib), pneumococcus, measles, and pertussis is a proven strategy to prevent pneumonia and other RTIs. Improving indoor air quality by reducing tobacco smoke and biomass fuel exposure, along with better ventilation, can significantly lower infection risks. Nutritional support, particularly addressing malnutrition, strengthens immune defenses and reduces RTI susceptibility. Health education, including handwashing practices, has been shown to decrease respiratory infections by 21% in children under five. Addressing socioeconomic disparities, improving maternal education, and reducing poverty are also essential in mitigating RTI risks, requiring comprehensive public health policies and targeted interventions.

LIMITATIONS

This single-center, cross-sectional study limits generalizability and causal inference of RTI risk factors. Lack of long-term follow-up prevents assessing disease progression and recurrence. Recall bias may have affected environmental exposure data, and potential risk factors like G6PD deficiency were underestimated due to limited screening. Sample size constraints may have influenced statistical power. Despite these limitations, the study underscores the need for broader, multi-center research to enhance RTI prevention and management strategies.

CONCLUSION

Respiratory tract infections remain a leading cause of morbidity and mortality among children under five, particularly in low- and middle-income countries. Identifying and addressing the multifaceted risk factors—ranging from environmental exposures and nutritional deficiencies to socioeconomic disparities and inadequate healthcare access—is crucial. Implementing integrated preventive strategies, including widespread immunization, environmental improvements, nutritional support, and health education, can substantially reduce the burden of RTIs in this vulnerable population. Continued research and policy efforts are essential to tailor interventions to specific contexts and ensure the health and well-being of children globally.

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