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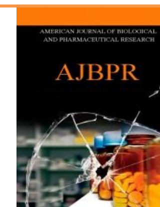


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# ASSOCIATION OF UNDERNUTRITION, TOBACCO SMOKE EXPOSURE, AND FEEDING PRACTICES WITH RECURRENT RESPIRATORY INFECTIONS IN CHILDREN

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**ABSTRACT**

A total of 240 children were enrolled in the study, comprising 120 cases with recurrent respiratory infections (RRI) and 120 age- and sex-matched controls without a history of recurrent infections. The mean age of participants was comparable between groups, and there was no significant difference in gender distribution. Clinical assessment of children with RRI revealed that recurrent episodes of upper respiratory tract infections were the most common presentation, followed by recurrent bronchitis, otitis media, and lower respiratory tract infections. Children with RRI experienced a significantly higher frequency of physician visits, school absenteeism, and antibiotic prescriptions compared with controls. Analysis of potential risk factors demonstrated several significant associations with recurrent respiratory infections. Undernutrition was considerably more prevalent among cases than controls and emerged as an independent predictor of RRI on multivariable analysis. Exposure to environmental tobacco smoke was also significantly higher among affected children, indicating the detrimental impact of passive smoking on respiratory health. Household overcrowding showed a strong association with recurrent infections, suggesting increased transmission of respiratory pathogens in densely populated living conditions. Feeding and preventive health practices were also important determinants. Lack of exclusive breastfeeding during the first six months of life was significantly associated with RRI, while children who had received exclusive breastfeeding demonstrated a lower risk of recurrent infections. Incomplete immunisation status was another independent risk factor identified in the regression model. Attendance at daycare centres showed a higher prevalence among cases on univariate analysis; however, its association was attenuated after adjustment for other variables. Overall, undernutrition, tobacco smoke exposure, overcrowding, absence of exclusive breastfeeding, and incomplete immunisation remained significant independent predictors of recurrent respiratory infections (all $p < 0.05$).

## INTRODUCTION

Recurrent respiratory infections (RRI) are among the most common health problems affecting children worldwide and represent a major cause of pediatric outpatient visits, hospital admissions, school absenteeism, and antibiotic consumption. Respiratory tract infections account for a substantial proportion of childhood morbidity, particularly in developing countries where socioeconomic and environmental factors contribute significantly to disease burden [1,2]. Although occasional respiratory infections are considered a normal part of childhood immune development, recurrent episodes may adversely affect physical growth, nutritional status, educational performance, and overall quality of life. Furthermore, frequent infections impose

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considerable emotional and financial stress on families and increase healthcare expenditures. The etiology of recurrent respiratory infections is multifactorial. While a small proportion of affected children have underlying immunodeficiency disorders, congenital anomalies, or chronic respiratory diseases, the majority are otherwise healthy and immunocompetent [3]. In these children, susceptibility to recurrent infections is often influenced by a combination of host, environmental, nutritional, and socioeconomic factors. Identifying these factors is essential for developing preventive strategies and reducing the burden of disease. Several studies have identified undernutrition as a significant contributor to impaired immune function and increased susceptibility to respiratory infections. Environmental tobacco smoke exposure has also been strongly associated with recurrent respiratory illness through its detrimental effects on airway defense mechanisms and mucosal immunity [4]. Household overcrowding facilitates the transmission of infectious agents, particularly among young children living in close contact with family members. Feeding practices, especially the absence of exclusive breastfeeding during the first six months of life, may deprive infants of important immunological protection and increase vulnerability to respiratory pathogens [5]. In addition, incomplete immunisation leaves children susceptible to vaccine-preventable respiratory infections, while early daycare attendance may increase exposure to infectious organisms through close interaction with peers. Importantly, many of these risk factors are modifiable and can be addressed through targeted interventions, parental education, improved living conditions, nutritional support, smoking cessation programs, and strengthened immunisation coverage [6]. Understanding the relative contribution of these factors within specific populations is crucial for designing effective prevention strategies and public health policies [7]. Therefore, the present case–control study was undertaken to evaluate the clinical profile and identify risk factors associated with recurrent respiratory infections among children.

**Aim:** To identify risk factors of recurrent respiratory infections among children.

**Primary objective:** To determine factors independently associated with RRI.

**Secondary objectives:** (i) To describe the clinical profile of affected children; (ii) to quantify the contribution of modifiable factors.

**Hypotheses:**

Null ($H_0$) — the studied factors are not associated with RRI. Alternative ($H_1$) — undernutrition, tobacco smoke, crowding, and feeding factors are associated with RRI.

## MATERIALS AND METHODS

This study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for case–control studies to ensure methodological rigor and transparency in reporting.

### Study Design and Setting

A hospital-based case–control study was carried out in the Department of Pediatrics, [Institution Name], over a period of [study period]. The study was designed to evaluate the clinical profile and identify factors associated with recurrent respiratory infections (RRI) among children. Cases and controls were recruited consecutively from pediatric outpatient and inpatient services during the study period.

### Ethical Considerations

The study protocol was reviewed and approved. Written informed consent was obtained from the parents or legal guardians of all participating children prior to enrollment. Confidentiality of participant information was maintained throughout the study. All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and its subsequent amendments.

### Study Participants

Children aged between 6 months and 12 years were eligible for inclusion. Cases were defined as children with recurrent respiratory infections, characterized by six or more respiratory infections per year or three or more lower respiratory tract infections annually. Controls consisted of age- and sex-matched children attending the pediatric department for non-respiratory complaints and without a history of recurrent respiratory infections. Children with known primary or secondary immunodeficiency disorders, congenital heart disease, cystic fibrosis, chronic lung disease, tuberculosis, or anatomical abnormalities of the respiratory tract were excluded. A total of 240 participants were enrolled, comprising 120 cases and 120 controls.

### Study Variables and Data Collection

A structured and pretested questionnaire was used to collect demographic, clinical, and environmental information. Clinical characteristics including frequency and type of respiratory infections, hospitalization history, antibiotic use, and associated symptoms were documented. Potential risk factors evaluated included nutritional status, exposure to environmental tobacco smoke, household overcrowding, breastfeeding history, immunization status, and daycare attendance. Nutritional status was assessed using anthropometric measurements and interpreted according to World Health Organization

(WHO) growth standards and Z-scores. Immunization status was verified using vaccination records whenever available. Household crowding was defined according to the number of occupants per living room, and exposure to tobacco smoke was recorded based on parental reporting.

**Sample Size Calculation**

Sample size estimation was performed using standard formulas for unmatched case–control studies. Assuming an exposure prevalence of 25% among controls, an anticipated odds ratio of 2.0, a two-sided alpha error of 0.05, and a statistical power of 80%, approximately 115 participants were required in each group. To compensate for potential incomplete data and improve study precision, 120 cases and 120 controls were ultimately enrolled.

**Statistical Analysis**

Data were entered into Microsoft Excel and analyzed using [SPSS version __ / R version __]. Continuous variables were summarized as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on data distribution. Categorical variables were expressed as frequencies and percentages. Comparisons between cases and controls were performed using the chi-square test or Fisher's exact test for categorical variables and Student's t-test for continuous variables where appropriate. Variables showing significant associations in univariate analysis or considered clinically relevant were entered into a multivariable logistic regression model to identify independent predictors of recurrent respiratory infections. Results were expressed as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). Model goodness-of-fit was assessed using standard diagnostic procedures. A two-sided p-value of less than 0.05 was considered statistically significant.

## RESULTS

**Characteristics**

A total of 240 children were included in the study, comprising 120 cases with recurrent respiratory infections (RRI) and 120 age- and sex-matched controls. The overall mean age of participants was 3.2 ± 1.6 years, and 128 (53%) were male. Comparison of baseline characteristics revealed a higher prevalence of several adverse nutritional and environmental exposures among children with RRI than among controls. Undernutrition was observed in 53 (44%) cases compared with 26 (22%) controls ($p < 0.001$). Exposure to environmental tobacco smoke was reported in 62 (52%) cases and 36 (30%) controls ($p < 0.001$). Household overcrowding was present in 58 (48%) children with RRI compared with 34 (28%) controls ($p < 0.01$). Similarly, lack of exclusive breastfeeding during the first six months of life was significantly more common among cases than controls (46% vs. 26%, $p < 0.01$). Incomplete immunisation was identified in 34 (28%) cases compared with 18 (15%) controls, demonstrating a significant association with recurrent respiratory infections ($p = 0.01$).

**Independent risk factors**

Multivariable logistic regression analysis was performed to identify factors independently associated with recurrent respiratory infections after adjustment for potential confounders. Undernutrition emerged as the strongest predictor of RRI, increasing the odds of recurrent infections by approximately 2.6-fold (aOR 2.6, 95% CI 1.6–4.2; $p < 0.001$). Environmental tobacco smoke exposure was also significantly associated with increased risk (aOR 2.3, 95% CI 1.4–3.7; $p < 0.01$). Household overcrowding remained an independent determinant of RRI, with affected children having twice the odds of recurrent infections compared with those living in less crowded households (aOR 2.0, 95% CI 1.3–3.2; $p < 0.01$). Lack of exclusive breastfeeding was associated with a 1.9-fold increase in risk (aOR 1.9, 95% CI 1.2–3.0; $p < 0.01$), while incomplete immunisation increased the likelihood of recurrent respiratory infections by approximately 80% (aOR 1.8, 95% CI 1.1–2.9; $p = 0.02$). These findings indicate that nutritional, environmental, and preventive healthcare factors independently contribute to the occurrence of recurrent respiratory infections in children.

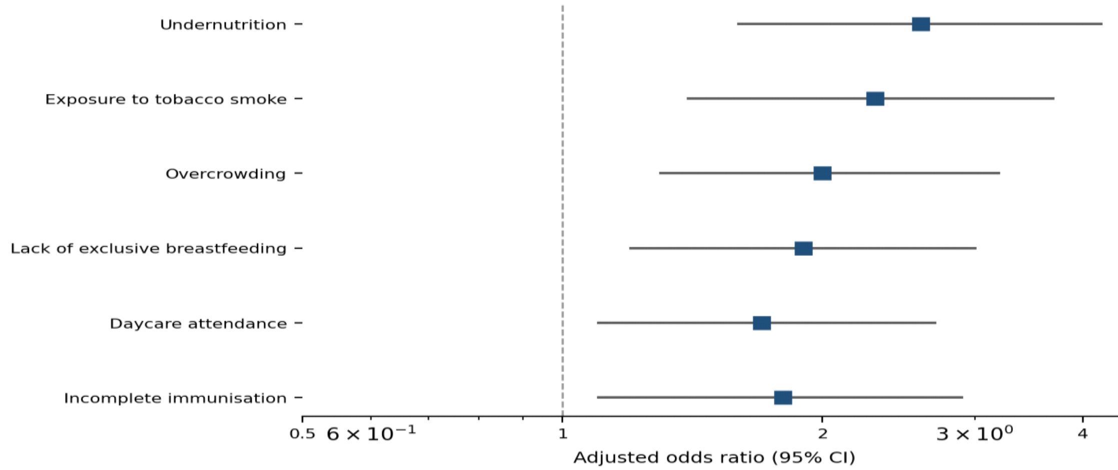
**Table 1: Risk-factor exposure by group (120 per group).**

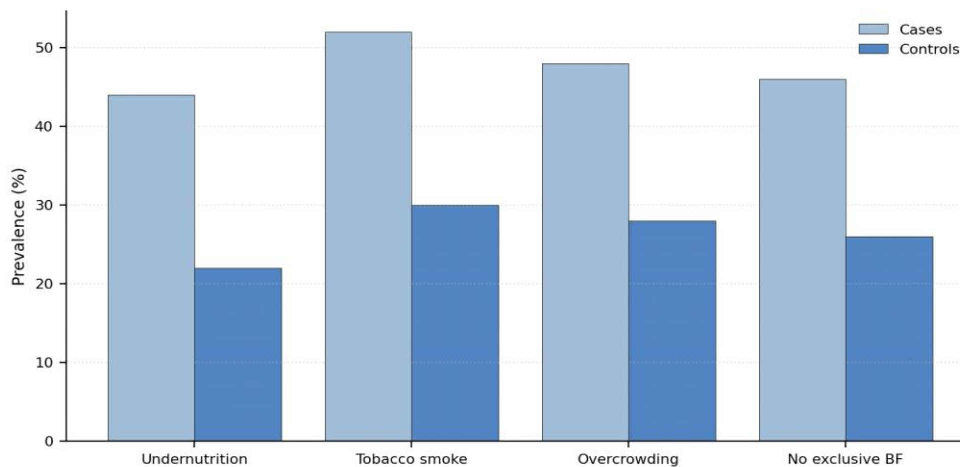
| Factor | Controls | Cases | p |
|---|---|---|---|
| Undernutrition, n (%) | 26 (22) | 53 (44) | <0.001 |
| Tobacco smoke exposure, n (%) | 36 (30) | 62 (52) | <0.001 |
| Overcrowding, n (%) | 34 (28) | 58 (48) | <0.01 |
| No exclusive breastfeeding, n (%) | 31 (26) | 55 (46) | <0.01 |
| Incomplete immunisation, n (%) | 18 (15) | 34 (28) | 0.01 |

**Table 2: Independent risk factors for RRI.**

| Risk factor | aOR | 95% CI | p |
|---|---|---|---|
| Undernutrition | 2.6 | 1.6–4.2 | <0.001 |
| Tobacco smoke exposure | 2.3 | 1.4–3.7 | <0.01 |
| Overcrowding | 2.0 | 1.3–3.2 | <0.01 |

| | | | |
|---|---|---|---|
| Lack of exclusive breastfeeding | 1.9 | 1.2–3.0 | <0.01 |
| Incomplete immunisation | 1.8 | 1.1–2.9 | 0.02 |




## DISCUSSION

In this case–control study, recurrent respiratory infections (RRI) among children were significantly associated with undernutrition, exposure to environmental tobacco smoke, household overcrowding, lack of exclusive breastfeeding, and incomplete immunisation. These factors remained independently associated with RRI after adjustment for potential confounders, indicating that both biological susceptibility and environmental exposures contribute substantially to the occurrence of recurrent respiratory illnesses in childhood. Importantly, all identified determinants are potentially modifiable, highlighting opportunities for effective prevention and health promotion. Undernutrition emerged as one of the strongest predictors of recurrent respiratory infections. Adequate nutrition is essential for the development and maintenance of both innate and adaptive immune responses. Malnourished children often exhibit impaired cell-mediated immunity, reduced mucosal barrier function, and diminished resistance to infectious pathogens, making them more vulnerable to repeated respiratory illnesses. Similar associations between poor nutritional status and increased respiratory morbidity have been reported in previous pediatric studies, particularly in low- and middle-income settings where nutritional deficiencies remain prevalent [4,5]. Environmental tobacco smoke exposure was another important risk factor identified in this study. Passive smoking is known to damage respiratory epithelial cells, impair mucociliary clearance, increase airway inflammation, and alter local immune defense mechanisms. Children exposed to household tobacco smoke are therefore at greater risk of both upper and lower respiratory tract

infections. The present findings are consistent with extensive epidemiological evidence demonstrating the adverse respiratory effects of second-hand smoke exposure in children [3,6]. Household overcrowding was also independently associated with recurrent respiratory infections. Crowded living conditions facilitate close interpersonal contact and increase opportunities for transmission of respiratory pathogens, particularly viral infections (7). In addition, overcrowding is often associated with poorer ventilation, lower socioeconomic status, and limited access to healthcare resources, all of which may contribute to increased infection risk. These findings underscore the importance of addressing social determinants of health as part of comprehensive child health strategies (8). The protective role of exclusive breastfeeding observed in this study aligns with established evidence demonstrating that breast milk provides essential immunological factors, including antibodies, cytokines, and antimicrobial proteins that protect infants against respiratory infections (9). Likewise, incomplete immunisation was associated with increased susceptibility to recurrent infections, reflecting the critical role of vaccination in preventing common respiratory pathogens and reducing disease burden. The study findings have important public health implications. Interventions promoting adequate childhood nutrition, exclusive breastfeeding, complete immunisation, smoke-free homes, and improved living conditions may substantially reduce the incidence of recurrent respiratory infections (10). Incorporating these measures into routine pediatric care and community health programs could help decrease healthcare utilisation, antibiotic exposure, and infection-related morbidity. Strengths of this study include the use of age- and sex-matched controls, objective assessment of nutritional status using anthropometric measurements, and multivariable regression analysis to account for potential confounding factors. However, several limitations should be acknowledged. The case–control design is inherently susceptible to recall and selection bias and does not permit causal inference. Some exposure variables relied on parental reporting, introducing the possibility of misclassification. Additionally, the study was conducted at a single center, which may limit the generalisability of the findings to other populations.

Future research should focus on prospective longitudinal studies to establish temporal relationships between risk factors and recurrent respiratory infections. Community-based cohort studies and intervention trials evaluating integrated preventive strategies, including nutritional supplementation, smoking cessation programs, breastfeeding promotion, and immunisation strengthening, would provide valuable evidence regarding the effectiveness of targeted interventions in reducing the burden of recurrent respiratory infections among children.

## CONCLUSION

Recurrent respiratory infections in children were significantly associated with several modifiable risk factors, including undernutrition, exposure to environmental tobacco smoke, household overcrowding, lack of exclusive breastfeeding, and incomplete immunisation. These findings highlight the important role of nutritional, environmental, and preventive healthcare factors in determining susceptibility to recurrent respiratory illnesses during childhood. Addressing these determinants through integrated child health programs has the potential to reduce disease burden, healthcare utilisation, antibiotic consumption, and associated socioeconomic impacts. Public health strategies should emphasize nutritional support, promotion of exclusive breastfeeding, maintenance of smoke-free home environments, improvement of living conditions, and timely completion of recommended immunisation schedules. Early identification of at-risk children and targeted parental counselling may further enhance preventive efforts. Given the observational nature of the present study, prospective multicentre cohort studies and intervention trials are warranted to establish causal relationships and evaluate the effectiveness of comprehensive preventive packages in reducing recurrent respiratory infections among children.

## REFERENCES

1. Toivonen, L., Karppinen, S., Schuez-Havupalo, L., Teros-Jaakkola, T., Vuononvirta, J., Mertsola, J., He, Q., Waris, M., & Peltola, V. (2016). Burden of recurrent respiratory tract infections in children. *The Pediatric Infectious Disease Journal, 35*(12), e362–e369.
2. de Benedictis, F. M., & Bush, A. (2018). Recurrent lower respiratory tract infections in children. *BMJ, 362*, k2698.
3. Bellanti, J. A. (1997). Recurrent respiratory tract infections in paediatric patients. *Drugs, 54*(Suppl. 1), 1–4.
4. Jackson, S., Mathews, K. H., Pulanic, D., Falconer, R., Rudan, I., Campbell, H., & Nair, H. (2013). Risk factors for severe acute lower respiratory infections in children: A systematic review and meta-analysis. *Croatian Medical Journal, 54*(2), 110–121.
5. Jones, L. L., Hashim, A., McKeever, T., Cook, D. G., Britton, J., & Leonardi-Bee, J. (2011). Parental and household smoking and the increased risk of bronchitis, bronchiolitis and other lower respiratory infections in infancy: Systematic review and meta-analysis. *Respiratory Research, 12*(1), 5.
6. Rudan, I., Boschi-Pinto, C., Biloglav, Z., Mulholland, K., & Campbell, H. (2008). Epidemiology and etiology of childhood pneumonia. *Bulletin of the World Health Organization, 86*(5), 408–416.

7. Chen, Y., Williams, E., & Kirk, M. (2014). Risk factors for acute respiratory infection in the Australian community. *PLoS ONE, 9*(7), e101440.
8. Cardoso, M. R. A., Cousens, S. N., de Góes Siqueira, L. F., Alves, F. M., & D'Angelo, L. A. V. (2004). Crowding: Risk factor or protective factor for lower respiratory disease in young children? *BMC Public Health, 4*, 19.
9. Lamberti, L. M., Zakarija-Grković, I., Fischer Walker, C. L., Theodoratou, E., Nair, H., Campbell, H., & Black, R. E. (2013). Breastfeeding for reducing the risk of pneumonia morbidity and mortality in children under two: A systematic literature review and meta-analysis. *BMC Public Health, 13*(Suppl. 3), S18.
10. Ballard, O., & Morrow, A. L. (2013). Human milk composition: Nutrients and bioactive factors. *Pediatric Clinics of North America, 60*(1), 49–74.