Original Article
DOI: https://doi.org/10.70749/ijbr.v3i6.2045

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Association between Acute Respiratory Infection and Type of Feeding in Children up to 2 Years of Age: A Comparative Study of Breast Feeding, Formula Feeding and Mixed Feeding in CMH Abbottabad

Hamid Roshan[1], Syed Taqi Hasan Zaidi[2], Amjad Iqbal[1], Abdul Khaliq[1], Safia Mahsud[3]

[1]Department of Paediatrics, Khyber Teaching Hospital, Peshawar, KP, Pakistan.
[2]Department of Paediatrics, CMH Abbottabad, Abbottabad, KP, Pakistan.
[3]Department of Obstetrics and Gynaecology, Women and Children Hospital, Dera Ismail Khan, KP, Pakistan.

ARTICLE INFO

Keywords: Breastfeeding, Infants, Infant Formula, Respiratory Tract Infection.

Correspondence to: Hamid Roshan, Department of Paediatrics, Khyber Teaching Hospital, Peshawar, KP, Pakistan.
Email: hroshan101@gmail.com

Declaration
Authors' Contribution
All authors equally contributed to the study and approved the final manuscript

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 13-04-2025 Revised: 07-06-2025
Accepted: 19-06-2025 Published: 30-06-2025

ABSTRACT

Objectives: To determine the association between acute respiratory infection and type of feeding in children up to 2 years of age presenting at the pediatric outpatient department. **Study Design:** Case-control study. **Place and duration of study:** This study was conducted at the Department of Pediatrics, CMH Abbottabad, from October 2024 to March 2025. **Methods:** A total of 50 children aged ≤2 years presenting with acute respiratory infection were included in the study group. Another 50 children of the same age group without any diagnosis of infections or any serious illness were added in the control group. Interviews of mothers were conducted to find the feeding history of children during the first six months of life. Infants were then categorized into exclusive breastfeeding, exclusive formula feeding, and mixed feeding as per WHO classification. The association between feeding type and the incidence of infection was assessed using the chi-square test and odds ratios. **Results:** The mean age of children was 8.21±5.71 months with a predominant male population (61%). Exclusive formula feeding was the most common (60%), while exclusive breastfeeding was the least common (10%) in the study group. Conversely, exclusive breastfeeding was most common (56%) and exclusive formula feeding was least common (20%) in the control group. A statistically significant association was found between feeding type and the incidence of acute respiratory infection ($p < 0.0001$). Infants on exclusive formula feeding had significantly higher odds of developing the infection (OR: 16.8), whereas exclusive breastfeeding was associated with the lowest risk. **Conclusion:** A significant association was found between feeding practices and the risk of acute respiratory infection in children up to 2 years of age.

INTRODUCTION

Acute respiratory infections (ARIs) are among the leading causes of morbidity and mortality in children < 5 years of age. Among these, pneumonia alone is responsible for 0.9 million children deaths which means 15% of deaths around the globe.[1] The situation is more concerning in developing countries who share 95% of global childhood mortality (18 Million), where ARIs are in fact the 3rd leading cause of these incidences.[2] South Asia (SA) and sub-Saharan Africa are the most affected regions bearing most of this burden with highest morbidity and mortality rates underscoring alarming signs for our health care providers.[3]

The first two years of life are important for the healthy development of the immune system. Human breast milk contains a wide range of immunoprotective components, such as secretory immunoglobulin A (IgA), lactoferrin, lysozyme, and oligosaccharides. These bioactive components act synergistically in strengthening the mucosal immunity and reducing the colonization of respiratory pathogens.[4] Feeding practices (FP), especially breastfeeding (BF) thereby play an instrumental role in determining an infant's immune system development and susceptibility to the infections. With these benefits, exclusive breastfeeding (EBF) is proven to provide immunological protection against various infectious diseases including ARIs, by reducing the incidence and severity of infection.[5,6]

The World Health Organization (WHO) and other health authorities recommend EBF for the first six months of infancy, followed by continued BF with the addition of complementary feedings up to two years or beyond. However, these recommendations are not followed by large proportion of mothers, and infants are put on formula feeding (FF) or mixed feedings (MF).[7] FF is nutritionally adequate for infant growth; however, it lacks the immunoprotective properties present in the breast milk. Moreover, people living in developing countries have

limited access to clean water and lack appropriate knowledge of proper sterilization process, which increases the risk of contamination during preparation and storage of FF. MF, which includes a combination of BF and FF, is also a common FP among mothers. MF provides partial immunological protection to the infants; they however, remain vulnerable to infections including ARIs. It is important that the use of FF and MF is increasing due to factors like increasing trends of maternal employment, changing socioeconomic status, cultural beliefs, perceived milk insufficiency and sometimes recommendations of a health care provider.[8]

This link between infant FP and ARI is established with the international evidence confirming that feeding type supports in immune development and promotes respiratory health.[9] In Pakistan, our unique and distinct cultural norms and socioeconomic factors greatly influencing the FP in infants. Moreover, our low literacy rate, particularly in women, also significantly impacts FP. This situation underscores the need for assessing the impact of FPs on ARI risk in children less than two years of age, however, limited work is done on this subject in Pakistan.[10]

CMH Abbottabad is located at a place where patients come from various surrounding cities representing different local and cultural norms related to child healthcare. This study was therefore planned to find the association between ARI and type of feeding in children up to 2 years of age. The results of this study will provide evidence-based insights to our pediatricians that will be helpful in understanding the incidences of ARIs in our local population and therefore parental counseling on this subject.

METHODOLOGY

This case-control study was conducted at the Department of Pediatrics, CMH Abbottabad, from Oct-2024 to Mar-2025 over a period of 6 months. Prior approval of conducting the study was received from the ethical committee of the hospital.

Sample size was calculated using OpenEpi as per following details:

Overall prevalence of ARI in infants up to 2 years of age = 22%.[11]

Prevalence of ARI in children on MF = 77.2%.[12]

With a confidence interval of 95% and power 90% the estimated sample size per group was 42 children (cases and controls), calculated based on the difference in the prevalence between the two populations. We however took a sample size of total 100 infants with 50 in each group to account for any drop out cases.

A total of 50 children aged ≤ 2 years presenting at the outpatient department (OPD) with ARI (defined as the presence of cough, rhinorrhea, nasal congestion, or wheezing with or without fever) were included in this study through consecutive sampling. Another 50 children belonging to the same age group present at the OPD for reasons other than ARI or any serious disease were included in the control group.

Exclusion criteria were set as children with any congenital respiratory anomalies, immunodeficiencies, chronic respiratory conditions, or underlying cardiac diseases. Children with a recent history of antibiotic use (within last seven days) were also excluded.

A written informed consent was taken from each parent/guardian before inclusion of their children in the study. All the relevant demographics were recorded for each child. Mother of each child included in this study (both study group and the control group) was interviewed to find the details of feeding history (during first six months of their life) and the hygiene practices at their home especially while preparing the formula milk (if relevant). As per the guidance of WHO, children were then categorized as EBF (received only breast milk, with no other liquids or solids except for ORS, vitamins, or prescribed medicines), EFF (exclusively fed on infant formulas) and MF (received both breast milk and formula with or without other liquids or solids).[13]

Data were analyzed using SPSS version 26. Descriptive statistics were employed to summarize the data where continuous variables were presented as mean ± standard deviation (SD), while categorical variables were shown as frequencies and percentages. The significance of association between feeding type and occurrence of ARI was determined by applying the chi-square test on the outcomes of the two groups. Crude odds ratios (OR) with 95% confidence intervals (CI) were calculated to estimate the strength of association. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The mean age of children in this study was 8.21±5.71 months with a range of 1-23 months. The number of males was 61 (61%) while females were 39 (39%) in overall study population. The group wise demographics and clinical details are shared in Table-I.

Table I

Group wise demographics and clinical details (n =100)

Demographics and clinical details		Study group (n=50)	Control group (n=50)
Age (Mean± SD) months		8.02±5.72	8.4±5.74
Gender	Male n (%)	30 (60)	31 (62)
	Female n (%)	20 (40)	19 (38)
Residential status	Urban n (%)	22 (44)	24 (48)
	Rural n (%)	28 (56)	26 (52)
Educational status of mother	Higher secondary n (%)	8 (16)	10 (20)
	Secondary n (%)	15 (30)	15 (30)
	Primary n (%)	17 (34)	18 (36)
	Uneducated n (%)	10 (20)	7 (14)
Duration of symptoms (Mean± SD) days		2.72±1.31	N/A

The results showed that highest number of infants in the study group was on EFF (60%) and the lowest on EBF (10%). This is in contrast to the control group where highest number was on EBF (56%) and lowest number on EFF (20%). A statistically significant association was found between the feeding type and the incidence of ARI ($p < 0.0001$) as shown in Table-II.

Table II

Comparison of feeding practices between the study and control groups (n=100)

Feeding practices	Study group (n=50)	Control group (n=50)	p-value/χ^2
Exclusive formula feeding n (%)	30 (60)	10 (20)	
Mix feeding n (%)	15 (30)	12 (24)	<0.0001/26.36
Exclusive breast feeding n (%)	5 (10)	28 (56)	

Infants who were on EFF had significantly higher odds of developing ARI (OR: 16.8), while those on MF showed a trend toward increased risk (OR: 2.3) but it was not statistically significant. These results highlighted the protective effect of breast milk as shown in Table-III.

Table III

Association between Feeding Type and Risk of ARI (n=100)

Comparison	Odds ratio (OR)	95% Confidence Interval (CI)	p-value
EFF vs EBF	16.8	5.1-55.3	< 0.001
MF vs EBF	2.3	0.7-7.3	0.16

DISCUSSION

The results of our study showed that EFF was most common (60%), while EBF was least common (10%) in children reported with the incidence of ARI. Conversely, EBF was most common (56%) and EFF was least common (20%) in the control group. A statistically significant association was found between feeding type and the incidence of acute respiratory infection ($p < 0.0001$). Infants on exclusive formula feeding had significantly higher odds of developing the infection (OR: 16.8), while exclusive breastfeeding had the lowest risk. These results are consistent with prior studies conducted on this topic especially those conducted in low income countries with constrained healthcare systems.

In a study conducted in India, Sharma R et al. found that BF was highly effective intervention for protecting infants against infectious diseases, including ARI. The incidence of pneumonia was notably higher up to 54.5% among infants on MF compared to infants who were exclusively BF. It was important observation that both MF and EFF were significantly associated with increased risk of infections while longer BF duration (beyond four months) was linked with reduced morbidity.[12] Similar findings were shared by Raja SR et al. who reported the incidence of ARI to be 10.95% in Indian children presenting at a tertiary hospital. Pneumonia (38.5%) and bronchiolitis (15.3%) were most common respiratory infections. The study found that absence of EBF significantly increased the ARI severity ($p<0.002$) and the incidence of mortality ($p<0.04$), while the malnutrition worsened the overall outcomes.[14] A recent study conducted in Ghana also found that feeding type significantly influenced the risk of respiratory infection. Children who were not on BF had 2.62 times higher odds of developing ARI compared to children on EBF. BF was identified as a protective factor against all types of respiratory illness alongside other maternal and household factors.[15]

Similar results were reported by Mir F et al. in a study performed in Pakistan to find the association between ARI and FP in rural areas. This case control study found that EBF reduced the ARI risk (OR 0.81, 95% CI: 0.69–0.97) and concluded that promoting BF and managing comorbidities can help to reduce ARI burden in our rural settings.[16]

Pandolfi E et al. in a case-control study found a complex association between BF and viral ARI. Increased risk of viral infection was observed in EFF infants at symptom onset (OR 3.7) due possibly increased risk of viral transmission during close contact with mothers. However, longer duration of BF practice was protective against infection (OR 0.98), strongly supporting the EBF.[17]

The protective role of EBF has also been emphasized in broader reviews. A systemic review conducted in Nigeria including 12 studies on this topic concluded that EBF plays a crucial role in reducing the risk and severity of ARIs in infants. The review revealed that non-EBF infants had a 4-fold higher risk of developing ARIs compared to those on EFF. The mechanism of this protection was explained by the presence of essential immune factors like secretory IgA, lactoferrin, and lysozyme, which help in enhancing respiratory defense.[18] Collectively, these findings are aligned with global recommendations and reinforce the vital role of EBF in reducing the risk and severity of ARI in early childhood, providing a healthy childhood to the infants especially in resource-limited settings.

The limitations of our study include its single-center study design which may limit generalizability of these results. Moreover, there may be a recall bias from maternal interviews about FPs that can affect the results.

CONCLUSION

A significant association is found between feeding practices and the incidence of ARIs in children under 2 years of age. EBF showed strong protective effects, while EFF was linked to a significantly higher risk of these infections. MF also posed an intermediate risk of ARI. Despite these proven benefits, BF is not fully practiced in our society due to cultural norms, limited education of mothers on this topic and increasing maternal employment. These findings underscore the importance of promoting EBF in mothers through all possible measures including direct contacts, social and electronic media to disseminate this life-saving practice for infants in resource-limited populations.

REFERENCES

1. Unicef. (2020). Levels & trends in child mortality: report 2020: estimates/developed by the UN inter-agency group for child mortality estimation. New York, NY: UNICEF, WHO, World Bank, United Nations Population Division (2020). https://policycommons.net/artifacts/8976892/levels-trends-in-child-mortality/9855066/
2. Roselany, R., & Surjono, E. (2023). Pneumonia clinical features in under-five children treated in Atma Jaya hospital in 2017-2020. *Majalah Kedokteran Bandung*, *55*(1). https://doi.org/10.15395/mkb.v55n1.2966
3. Frigati, L., Greybe, L., Andronikou, S., Eber, E., Sunder B. Venkatakrishna, S., & Goussard, P. (2025). Respiratory

infections in low and middle-income countries. *Paediatric Respiratory Reviews*, *54*, 43-51. https://doi.org/10.1016/j.prrv.2024.08.002
4. Froń, A., & Orczyk-Pawiłowicz, M. (2023). Understanding the immunological quality of breast milk in maternal overweight and obesity. *Nutrients*, *15*(24), 5016. https://doi.org/10.3390/nu15245016
5. Alotiby, A. A. (2023). The role of breastfeeding as a protective factor against the development of the immune-mediated diseases: A systematic review. *Frontiers in Pediatrics*, *11*. https://doi.org/10.3389/fped.2023.1086999
6. Lokossou, G. A., Kouakanou, L., Schumacher, A., & Zenclussen, A. C. (2022). Human breast milk: From food to active immune response with disease protection in infants and mothers. *Frontiers in Immunology*, *13*. https://doi.org/10.3389/fimmu.2022.849012
7. World Health Organization. (2023). *WHO Guideline for complementary feeding of infants and young children 6-23 months of age*. World Health Organization. https://www.ncbi.nlm.nih.gov/books/NBK596423/
8. Hashim, M., Rizk, R., Abbas, N., Abdelrahim, D. N., Hasan, H., Obaid, R. S., Al-Ghazal, H., Al Hilali, M., Naja, F., & Radwan, H. (2025). Publisher correction: Infant and young child feeding practice status and its determinants in UAE: results from the MISC cohort. *International Breastfeeding Journal*, *20*(1). https://doi.org/10.1186/s13006-025-00700-0
9. Frank, N. M., Lynch, K. F., Uusitalo, U., Yang, J., Lönnrot, M., Virtanen, S. M., Hyöty, H., & Norris, J. M. (2019). The relationship between breastfeeding and reported respiratory and gastrointestinal infection rates in young children. *BMC Pediatrics*, *19*(1). https://doi.org/10.1186/s12887-019-1693-2
10. Shahbaz, M., Saleem, J., Hameed, S., Javed, F., Sahar, R., Khan, A., Jamshed, S., & Ijaz, F. (2024). Cultural and socioeconomic determinants of mother's complementary feeding practices on nutritional status of children under five: A cross-sectional study in Lahore, Pakistan. *Pakistan Journal of Health Sciences*, 212-217. https://doi.org/10.54393/pjhs.v5i10.2454
11. Gebrerufael, G. G., & Hagos, B. T. (2023). Prevalence and predictors of acute respiratory infection among children under-five years in Tigray Regional State, northern Ethiopia: A cross sectional study. *BMC Infectious Diseases*, *23*(1). https://doi.org/10.1186/s12879-023-08701-2
12. Sharma, R., Sood, A., & Niar, P. (2017). Infant feeding practices and risk of occurrence of diarrheal and respiratory infections in infancy-a hospital based study. *International Journal of Contemporary Pediatrics*, *4*(5), 1717. https://doi.org/10.18203/2349-3291.ijcp20173772
13. World Health Organization. (2023). *Infant and young child feeding*. Geneva: https://www.who.int/news-room/fact-sheets/detail/infant-and-young-child-feeding
14. Raja, S, R., Shabin, J., Mathivanan, M., & Subramanian, M. M. R. (2021). Study of respiratory disease pattern in children aged 2 months-5 years admitted in a tertiary care hospital. *International Journal of Contemporary Pediatrics*, *8*(6), 1070. https://doi.org/10.18203/2349-3291.ijcp20212050
15. Klu, D., Alhassan, A., & Dansu, C. A. (2025). Acute respiratory infections and its associated risk factors among children aged 6–59 months in Ghana: A multinomial regression analysis of the 2022 demographic and health survey. *Frontiers in Public Health*, *13*. https://doi.org/10.3389/fpubh.2025.1518427
16. Mir, F., Ariff, S., Bhura, M., Chanar, S., Nathwani, A. A., Jawwad, M., Hussain, A., Rizvi, A., Umer, M., Memon, Z., Habib, A., Soofi, S. B., & Bhutta, Z. A. (2022). Risk factors for acute respiratory infections in children between 0 and 23 months of age in a Peri-urban district in Pakistan: A matched case–control study. *Frontiers in Pediatrics*, *9*. https://doi.org/10.3389/fped.2021.704545
17. Pandolfi, E., Gesualdo, F., Rizzo, C., Carloni, E., Villani, A., Concato, C., Linardos, G., Russo, L., Ferretti, B., Campagna, I., & Tozzi, A. (2019). Breastfeeding and respiratory infections in the first 6 months of life: A case control study. *Frontiers in Pediatrics*, *7*. https://doi.org/10.3389/fped.2019.00152
18. George, A., Bonne, S., Ekpenyong, E. N., Edem, E. N., & Ajayi, S. (2024). BREASTFEEDING AND ACUTE RESPIRATORY INFECTION (ARI) IN INFANTS: A SYSTEMATIC REVIEW IN NIGERIA. *Annals of Ibadan Postgraduate Medicine*, *22*(3), 39. https://pmc.ncbi.nlm.nih.gov/articles/PMC12082678/