Pediatrics

Breastfeeding and its effect on the severity of acute respiratory illnesses in children under 5 years of age. A single-center observational study.

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Summary

Introduction: Acute respiratory diseases are a global public health problem, mainly affecting children under five. Breastfeeding significantly protects against these diseases by strengthening the infant's immune system. The study aimed to analyze the effect of inadequate breastfeeding on the severity of acute respiratory diseases in children under 5 years of age treated at the Dr. Francisco De Icaza Bustamante Hospital in 2022-2023.

Methods: Analytical study, retrospective, cross-sectional, observational type, using Chi-square and Odds Ratio with a 95% confidence interval.

Results: A total of 233 cases were included. Most infants were fed mixed (46.8%) or exclusive (43.8%) breastfeeding, reflecting a preference for breastfeeding. Pneumonia was the most common respiratory illness (86.3%), and respiratory failure complicated 33% of cases. Exclusive breastfeeding reduces respiratory complications and the need for respiratory support.

Conclusions: Exclusive breastfeeding reduces respiratory complications, while pneumonia is the leading cause of hospitalization in children under five years of age.

Keywords :

Breastfeeding, acute respiratory diseases, pediatrics, severity, complications, respiratory support.

Abbreviations

CI: Confidence interval.
OR: Odds ratio.

Additional information

No supplementary materials were declared.

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Authors' contributions

Tanisha del Cisne Cajas Peralta: Conceptualization, data curation, formal analysis, funding acquisition, investigation, writing – original draft.
Danny Gabriel Salazar Pousada: Funding acquisition, Research, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing.
All authors read and approved the final version of the manuscript.

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Availability of data and materials

The datasets used and analyzed during the present study are available from the corresponding author upon reasonable request.

Introduction

Breastfeeding is a unique and defining reproductive trait of mammals that nourishes their young by providing them with nutrient-rich breast milk. In addition to being the best source of nutrition for the infant, breast milk confers meaningful and long-lasting maternal and infant health benefits, including proper development of the infant's immune system and programming of endocrine and metabolic functions [1].

Antibodies, cytokines, and other immune molecules in breast milk ensure immunity against diseases, protect the developing intestinal barrier from inflammation, and reduce the risk of chronic inflammatory diseases. In addition, hormones, cytokines, lipids, vitamins, and oligosaccharides in breast milk control organ differentiation, thermogenesis, and cognitive development, influence food preferences in infancy and initiate the growth of normal microbial flora. All of this can be lost with insufficient breastfeeding, which promotes childhood obesity and increases the risk of inflammatory diseases and diabetes later in life [1].

Currently, the impact of breastfeeding on respiratory health needs to be clarified. Epigenetic effects and modulation of the gut microbiota, lung growth, and immune system might explain the putative association between breastfeeding and lung function. It is generally recognized that breastfed infants have less frequent and severe respiratory infections than non-breastfed infants. Indeed, human milk provides immunological benefits by directly protecting specific components such as lactoferrin, lysozyme, defensin, and other cytokines. It also stimulates the immune system due to its high content of growth factors and nucleotides [2].

Recently, it has been assumed that breastfeeding could also directly affect lung growth. It is claimed that the effect of breastfeeding on the respiratory system could result from complex interactions between protective immunoreactive factors and mechanical impact. The latter consists of a longer sucking of the breast compared to the bottle, which could determine an increase in lung capacity in breastfed children compared to those fed with a bottle. In addition, breastfeeding could benefit the development of the alveolar-capillary membrane due to the presence of long-chain polyunsaturated fatty acids, phytochemicals, and angiopoietins in breast milk [2].

Likewise, breastfeeding is geared to the needs of the newborn. It can compensate for the relative inadequacy of host defenses by delivering substantial amounts of nonspecific and pathogen-specific secretory IgA (sIgA). These substances are present in addition to the antibodies in breast milk [3].

Immunological, hormonal, enzymatic, trophic, and bioactive substances in breast milk may provide passive protection. Other components, including macrophages and leukocytes, predominantly present at the beginning of lactation, may have a more substantial modulatory influence on the newborn's immune system and provide more excellent protection [3].

In addition to antibodies, breast milk contains several antimicrobial factors. These include lactoferrin, which binds iron and limits its availability to microorganisms, and lysozyme, which destroys bacteria's cell walls. These components inhibit the growth of pathogenic bacteria and viruses in the infant's respiratory tract, thereby reducing the risk of infections [5].

Live leukocytes, including macrophages and T and B lymphocytes, are transferred through breast milk. These immune cells strengthen the infant's immune response by phagocytosing pathogens, presenting antigens, and producing additional antibodies. In addition, breast milk contains anti-inflammatory factors, such as cytokines and growth factors, which may reduce inflammation and tissue damage in the respiratory tract by modulating the infant's inflammatory response to infections [4, 5].

Finally, breastfeeding promotes the development of a healthy gut microbiota in the infant, composed primarily of beneficial bacteria such as Bifidobacterium and Lactobacillus. This balanced microbiota is associated with a better overall immune response and may protect against the colonization of respiratory pathogens by competing for resources and space in the gut [4, 5].

A study conducted at Batanan III Primary Health Centre, Bali, found that 49% of children under five were exclusively breastfed and 51% were not. Previous studies have shown that breastfeeding can prevent acute respiratory and gastrointestinal infections until 6 months of age and protects against diseases such as otitis media even after breastfeeding ceases [6].

The objective of this study was to analyze the effect of inadequate breastfeeding on the severity of acute respiratory diseases in children under 5 years of age treated in a regional public pediatric referral hospital in Guayaquil, Ecuador.

Materials and methods

Study design

This observational study is analytical. The source is retrospective.

Scenery

The study was conducted at the Dr. Francisco de Icaza Bustamante Children's Hospital of the Ministry of Public

Health of Ecuador in Guayaquil, Ecuador. It lasted from January 1, 2022, to December 31, 2023.

Participants

Records of patients between 6 months and 5 years of age hospitalized for respiratory diseases for whom detailed information was available on feeding modality during the first 6 months of life were excluded. Patients with postprocedural respiratory disorders; patients with lung diseases due to external agents; children with preexisting chronic conditions affecting the respiratory system; children diagnosed with protein-calorie malnutrition; patients with congenital or acquired pathologies of the digestive system that compromise adequate food intake or absorption; and children with congenital or acquired immunodeficiencies were excluded.

Variables

The variables were age, sex, feeding modality in the first 6 months of life, acute respiratory illness, length of hospitalization, whether admission to the intensive care unit was required, need for respiratory support, presence of complications during hospitalization, type of complication during hospitalization, hospital readmissions, and mortality.

Data sources/measurements

The source was indirect; an electronic form was filled out from the data in the medical records. Records with the following ICD-10 codes were included: (J02) Acute pharyngitis, (J03) Acute tonsillitis, (J09-19) Influenza and pneumonia, (J01) Acute sinusitis, (J06) Acute upper respiratory infections of multiple sites and unspecified sites, (J22) Acute lower respiratory infection, unspecified, (J19) Acute bronchitis, (J04) Acute laryngitis and tracheitis.

Biases

Applying the participant selection criteria avoided observation and selection bias. To prevent interviewer, information, and memory biases, the principal investigator kept the data using a guide and records approved in the research protocol. Two researchers independently analyzed each record in duplicate, and the variables were recorded in the database once their concordance was verified.

Study size

The sample was probabilistic. According to INEC data, there are 4.392 million inhabitants in Guayas, with a population under 5 years of age of 4.33%, corresponding to 190,173 children as the Universe. With an expected frequency of respiratory diseases of 18%, a confidence limit of 5%, and a confidence interval of 95%, the sample size was 227 cases. The EPI info ™ program (Version 7.2.5, CDC, Atlanta, USA, September 2022) was used for the sample calculation.

Quantitative variables

Descriptive statistics were used. Results are expressed as frequency and percentage. Categorical variables were not converted into quantitative variables.

Statistical analysis

1. Descriptive Statistics: Qualitative variables were analyzed with frequency and percentages, while quantitative variables were described using central tendency and dispersion measures.
2. Inferential statistics: The Chi-square test was used to analyze the association between categorical variables, such as feeding modality and severity of respiratory diseases (admission to ICU, need for respiratory support, complications, and mortality). Then, the Odds Ratio (OR) was calculated with a 95% confidence interval and a significance level of 0.05 to analyze whether the feeding method influences the severity variables, that is, to determine whether a specific type of feeding is more risky or on the contrary, protective, for the severity variable. The statistical package used was IBM Corp., Released in 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Results

Participants

The study included 233 cases.

Main characteristics of the study group

There were 134 males (57.5%) and 99 females (42.5%). The average age was 19.3 ±15 months. The 25th percentile was 9 months, the 50th percentile was 12 months, and the 75th percentile was 24 months. 102 children (43.8%) were exclusively breastfed, 109 children (46.8%) were mixed-fed, and 22 cases (9.4%) were on formula. The frequency of respiratory diseases and hospital complications are presented in Table 1.

Relationship between feeding modality and the severity of acute respiratory diseases

There was no relationship between the history of the type of breastfeeding and the length of hospitalization, the need for admission to intensive care, the need for hospital readmissions, and mortality.

Table 1. Demographic and clinical characteristics of the study group.

	N=233	Percentage
Respiratory disease		
Pneumonia	201	86.3%
Bronchopneumonia	10	4.3%
Bronchitis acute	9	3.9%
Tonsillitis acute	3	1.3%
Pharyngitis acute	3	1.3%
Bronchiolitis acute	2	0.9%
Influenza	2	0.9%
Laryngotracheitis	2	0.9%
Sinusitis acute	1	0.4%
Hospital complications		
None	126	54.1%
Acute respiratory failure	77	33.0%
Pleural effusion	16	6.9%
Seizures	10	4.3%
Septic shock	3	1.3%
Acute otitis media	1	0.4%

Table 2. Clinical results according to nutritional history.

Duration of hospitalization					
	< 10 Days n=165	**>10 Days n=68**	***P***	**OR**	**IC 95%**
Mixed breastfeeding	82 (49.7%)	27 (39.7%)	0.165	0.667	0.376 — 1,183
Breastfeeding	68 (41.2%)	34 (50%)	0.219	1.426	0.809 — 2.516
Infant formula	15 (9.1%)	7 (10.3%)	0.775	1.148	0.446 — 2.953
Admission to intensive care					
	No n=205	**Yes n=28**	***P***	**OR**	**IC 95%**
Mixed breastfeeding	94 (45.9%)	15 (53.6%)	0.443	1.363	0.617 –3.008
Breastfeeding	91 (44.4%)	11 (39.3%)	0.610	0.811	0.362 –1.817
Infant formula	20 (9.8%)	2 (7.1%)	0.657	0.712	0.157 –3.222
Need for ventilatory support					
	No n=107	**Yes n=126**	***P***	**OR**	**IC 95%**
Mixed breastfeeding	35 (32.7%)	74 (58.7%)	< 0.01	2.927	1,710 –5,011
Breastfeeding	63 (58.9%)	39 (31%)	< 0.01	0.313	0.183 –0.537
Infant formula	9 (8.4%)	13 (10.3%)	0.620	1.253	0.513 –3.056
Complications during hospitalization					
	No n=126	**Yes n=107**	***P***	**OR**	**IC 95%**
Mixed breastfeeding	42 (33.3%)	67 (62.6%)	< 0.01	3.350	1.954 — 5.743
Breastfeeding	74 (58.7%)	28 (26.2%)	< 0.01	0.249	0.143 — 0.435
Infant formula	10 (7.9%)	12 (11.2%)	0.394	1.465	0.607 — 3.539
Hospital readmissions					
	No n=223	**Yes n=10**	***P***	**OR**	**IC 95%**
Mixed breastfeeding	103 (46.2%)	6 (60%)	0.392	1,748	0.480 — 6.363
Breastfeeding	98 (43.9%)	4 (40%)	0.822	0.806	0.233 — 3.097
Infant formula	22 (9.9%)	0 (0%)	0.297	-	-
Mortality					
	No n=229	**Yes n=4**	***P***	**OR**	**IC 95%**
Mixed breastfeeding	107 (46.7%)	2 (50)	0.896	1.140	0.158 — 8.234
Breastfeeding	100 (43.7%)	2 (50)	0.800	1,290	0.179 — 9.318
Infant formula	22 (9.6%)	0 (0)	0.515	-	-

OR: Odds ratio. CI: confidence interval

There was a statistical association between the absence of need for ventilatory support in children with a history of exclusive breastfeeding 58.9% versus 31.0% (P <0.01) (Table 2). The history of mixed breastfeeding was a risk factor for the need for ventilatory support OR 2.927 (95% CI 1.71-5.01; P <0.01). Children with a history of exclusive breastfeeding had a protective factor for the presence of complications during hospitalization OR: 0.249 (95% CI 0.143-0.435 P <0.01). Mixed breastfeeding was a risk factor for hospital complications OR: 3.35 (95%CI 1.954-5.743; P <0.01) (Table 2).

Discussion

In the present study, most patients with acute respiratory illnesses were male (57.5%), with a mean age of 1 year and 8 months, and half were younger than 1 year; similar reports have been published [7, 8]. These findings suggest that, although the mean age may vary, children younger than 2 years, especially males, are consistently the most affected by acute respiratory illnesses.

Another point to highlight is the feeding modality of children under 6 months, where it was evident that most children (46.8%) received a combination of breast milk and formula, while 43.8% were fed exclusively with breast milk. Only 9.4% of children received formula as the only source of nutrition. These findings suggest considerable adherence to breastfeeding recommendations since the WHO recommends exclusive breastfeeding during the first six months due to its proven health benefits, such as reducing children's acute respiratory and gastrointestinal infections. This contrasts with studies from Singapore, with an exclusive breastfeeding prevalence of 80.2% [9], and coincides with studies from Ethiopia, with an exclusive breastfeeding prevalence of 47% [10].

Regarding the type of acute respiratory disease, this research observed that pneumonia was the most frequent, affecting 86.3% of children, with bronchopneumonia and acute bronchitis to a lesser extent (4.3% and 3.9%, respectively), because it was the most common cause of hospital admission.

In the present study, exclusive breastfeeding was associated with a 70% reduction in the likelihood of needing ventilatory support, with an odds ratio (OR) of 0.313 (P < 0.01). In contrast, mixed feeding showed a nearly threefold increased likelihood of needing respiratory support, with an OR of 2.927 (P < 0.01). Exclusive formula did not show a significant association in this regard, with an OR of 1.253 (P = 0.620). In comparison, Jang et al. [11] in 2019 in South Korea found that the mixed feeding group had an adjusted OR of 3.807 (95% CI, 1.22–11.90; P = 0.021) for oxygen therapy versus the exclusive breastfeeding group.

This indicates that, although the OR for exclusive breastfeeding in our study is lower (0.313), reflecting a reduction in the need for ventilatory support, the OR found by Jang et al. [11] shows a higher likelihood of oxygen therapy in the mixed breastfeeding group compared to exclusive breastfeeding. Thus, both studies agree that exclusive breastfeeding is associated with fewer respiratory interventions, although the exact impact may vary depending on the study context and methodology.

These results highlight the importance of exclusive breastfeeding to protect against severe respiratory complications. Our study demonstrated a significant reduction in the need for mechanical ventilation in exclusively breastfed infants, supporting the recommendation of this approach to improve respiratory outcomes in children with acute respiratory illness. However, mixed breastfeeding was associated with a higher need for respiratory intervention, which may indicate a lower immune protection efficacy than exclusive breastfeeding.

At ICU admission, the results of this study did not reveal significant differences between feeding methods: exclusive breastfeeding ($P = 0.610$, OR = 0.811), mixed feeding ($P = 0.443$, OR = 1.363), and formula ($P = 0.657$, OR = 0.712). However, the study by Jang et al. found that the rate of ICU admission was lower in the exclusive breastfeeding group compared with the mixed feeding and exclusive formula groups. However, this difference did not reach statistical significance ($P = 0.338$). Thus, in both our study and that of Jang et al., the differences in ICU admission between feeding methods were not statistically significant, suggesting that the type of feeding does not influence an increase in the demand for pediatric intensive care.

Regarding the length of hospitalization, our study showed no significant differences between the different feeding modalities: exclusive breastfeeding ($P = 0.219$, OR = 1.426) and exclusive formula ($P = 0.82$, OR = 1.148). Mixed feeding, although showing a trend towards longer length of hospitalization (> 10 days), also did not reach statistical significance ($P = 0.165$, OR = 0.667). However, the findings of Videholm et al. [12] in Sweden in 2020 offer a different view. Their study reveals that children not breastfed had a considerably higher risk of being hospitalized (OR = 1.89; 95% CI: 1.45–2.47) than exclusively breastfed for at least six months.

These results highlight the importance of prolonged breastfeeding in protecting against infections and reducing the need for hospitalization. In contrast to these findings, our study did not show a significant or protective benefit in the length of hospitalization associated with breastfeeding, suggesting that there may be differences in the characteristics of the groups studied or in factors that have not been considered in our research.

Conclusions

Exclusive breastfeeding is the most favorable option for children's respiratory health because it reduces the need for respiratory support and complications during hospitalization. In contrast, mixed feeding is associated with more complications and the need for respiratory support, while exclusive formula does not show significant benefits.

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Statements

Ethics committee approval and consent to participate

The bioethics committee of the Faculty of Health Sciences of the Catholic University of Santiago de Guayaquil approved the study.

Consent to publish

It was not required because the present study does not publish images, radiographs, or specific patient studies.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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