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Association between Acute Gastroenteritis and Type of Feeding in Infants up to 6 Months of Age: A Comparative Study of Breast Feeding, Formula Feeding and Mixed Feeding in CMH Abbottabad

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ABSTRACT

Objectives: To determine the association between acute gastroenteritis and type of feeding in infants up to 6 months of age presenting to the pediatric ward. **Study Design:** Case-control study. **Place and duration of study:** This study was conducted at the department of pediatrics, CMH, Abbottabad from Nov-2024 to Apr-2025. **Methods:** A total of 65 infants aged ≤ 6 months presenting with acute gastroenteritis were included in this study. Another 65 infants belonging to the same age group present for reasons other than any severe infection or disease were included in the control group. Mother of each infant included in this study was interviewed to find the details of feeding practices and infants were then classified as per WHO classification as exclusive breast feeding, exclusive formula feeding and mixed feeding. The association between feeding type and the incidence of acute gastroenteritis was assessed by applying the chi-square test between the results of study group and the controls. **Results:** The mean age of infants was 3.4±1.49 months. Highest number of infants in the study group were on exclusive formula feeding (44.6%), followed by mixed feeding (36.9%) and only 18.5% were on exclusive breast feeding in contrast to control group where this percentage was 13.9%, 35.4% and 50.8%, respectively. A statistically significant association was found between the feeding type and the incidence of acute gastroenteritis ($p < 0.001$). Infants who were on exclusive formula feeding had significantly higher odds of developing acute gastroenteritis (OR: 8.86), followed by those on mixed feeding (OR: 2.87), while exclusive breast feeding had the lowest risk. **Conclusion:** A significant association is found between feeding practices and the risk of acute gastroenteritis in infants aged ≤6 months.

INTRODUCTION

Acute gastroenteritis (AGE) is among the leading global challenges to infant health, AGE is in fact the major cause of morbidity and mortality in infants in developing countries during the first year of life. An alarming figure in the World Health Organization (WHO) report shows that diarrheal diseases are responsible for approximately 525,000 annual deaths in children aged < 5 years.[1,2]

The etiology of AGE in infants involves multiple infectious agents including viruses (Rotavirus, norovirus and adenovirus), and bacterial pathogens (Escherichia coli, Salmonella, and Shigella species). Numerous host and environmental factors are found to contribute to the incidences of AGE in infants, where type of feeding is mentioned as one of the most modifiable and influential determinants.[3,4] It is documented that infants under the age of six months are particularly vulnerable to gastroenteritis due to their immature immune systems and dependency on parents/caregivers for their nutritional needs and hygiene. Feeding practices during early infancy thereby plays a critical role in susceptibility to infections, especially frequency and severity of gastrointestinal (GI) infections.[5]

Breast milk is referred to as the "gold standard" during infancy as it provides not only the optimal nutritional composition but also serves as the source of bioactive components that contribute to the development of immune system to save the infant from infectious disease. The secretory immunoglobulin A (sIgA), lactoferrin, lysozyme, oligosaccharides, and various cytokines along with the growth factors present in the breast milk collectively work to create a healthy gut microbiome and forms a protective barrier against pathogens causing infections. These well documented benefits of breast milk

lead WHO and UNICEF to recommend exclusive breastfeeding for the first six months of infancy.[6]

Formula feeding may increase the risk of infection due to contamination at the stage of preparation (contaminated water and/or improper sterilization of the bottles and feeders), inadequate storage and handling during administration. Moreover, formula feeding also lacks the immunological components needed to prevent the chances of GI infections.[7]

Mixed feeding (MF) involving the combination of breastfeeding and formula feeding, is also a common feeding practice among mothers. The risk of GI infections persists in cases of mixed feeding; as infants receive some protective benefits from BF while still remain exposed to the potential risks caused by EFF. Factors leading the mothers to EFF or MF include the maternal employment, some perceived insufficiency of breast milk and some social/cultural beliefs.[8]

Studies have demonstrated that infants who receive FF and MF have higher rates of all types of infections including AGE and has significantly higher rates of hospital admissions due to GI infections.[9] Pakistan belongs to a region where socioeconomic conditions cause significant challenges in terms of water quality, sanitation infrastructure, and healthcare accessibility. Consequently, the country faces extreme challenges of high incidences and severity of GI infections among infants. The CMH Abbottabad is located in the mountainous region of Khyber Pakhtunkhwa province of Pakistan and serves a diverse population with varying socioeconomic backgrounds. Investigating the association between feeding patterns and AGE can provide a good insight of this child health concern regarding Pakistani population.[10]

This comparative study was therefore planned to determine the association between AGE and type of feeding in infants up to 6 months of age reporting the at pediatric ward, CMH, Abbottabad. The results of this study will provide insights to the health care providers to formulate better strategies and guidance for the parents regarding their infant feeding practices.

METHODOLOGY

This case-control study was conducted at the Department of Pediatrics, CMH Abbottabad, from Nov-2024 to Apr-2025 over a period of 6 months after approval from the ethical committee of the hospital.

Sample size was calculated using OpenEpi as per following details:

Overall prevalence of AGE in infants <6 months = 37.8%.[11]

Prevalence of AGE in bottle fed infants = 62.86%.[12]

With a confidence interval of 95% and power 90% the estimated sample size per group was 62 infants (cases and controls), calculated based on the difference in the prevalence between the two populations. We therefore took a sample size of total 130 infants with 65 in each group to account for any drop out cases.

A total of 65 infants aged ≤ 6 months presenting with AGE (defined as the passage of ≥ 3 loose or watery stools within the last 24-hour, with or without vomiting, and a duration of < 14 days.) were included in this study through consecutive sampling. Another 65 infants belonging to the same age group present in the ward for reasons other than any severe infection or disease (scheduled vaccinations, routine checkups etc.) were included in the control group. Exclusion criteria comprised of infants with any congenital GI anomalies, immunodeficiencies, or malabsorption syndromes. Infants with a history of antibiotic use within the past two weeks were also excluded.

Written informed consent was taken from the parents/guardian before their inclusion in the study.

All the Information regarding demographics, any recent history of illness and hygiene practices were gathered. Mother of each infant included in this study (both study group and the control group) was interviewed to find the details of feeding history and infants were then classified as exclusive breast feeding (EBF), Exclusive formula feeding (EFF) and mixed feeding (MF).

The classification was made as per WHO criteria where EBF meant those who were only breast fed with no liquid or solid (Except for oral rehydration solutions, vitamins, minerals, or prescribed medicines), EFF meant those who were only fed on commercially available formula and MF meant those who were fed with both breast milk and formula milk with or without any other solid and liquid.[13]

Data were analyzed using SPSS version 26. Descriptive statistics were employed to share the data where means and standard deviations were computed for continuous variables, while frequencies and percentages were used to present the categorical variables. The association between feeding type and AGE was assessed by applying the chi-square test between the results of study group and the controls. Crude odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to assess the strength of association. Statistical significance was established at a p-value<0.05.

RESULTS

The mean age of patients in this study was 3.4±1.49 months with a range of 1-6 months. The group wise details of demographics and clinical history is shared in Table 1.

Table 1

Group Wise Details of Demographics and Clinical History (n=130)

Demographics and clinical history		Study group (n=65)	Control group (n=65)
Age (Mean± SD) months		3.54±1.49	3.26±1.48
Gender	Male n (%)	39 (60)	42 (64.62)
	Female n (%)	26 (40)	23 (35.38)
Residential status	Urban n (%)	31 (47.69)	33 (50.77)
	Rural n (%)	34 (52.31)	32 (49.23)
Educational status of mother	Higher secondary n (%)	12 (18.46)	14 (21.54)
	Secondary n (%)	19 (29.23)	22 (33.85)
	Primary n (%)	22 (33.85)	21 (32.31)
	Uneducated n (%)	12 (18.46)	8 (12.31)
Duration of symptoms (Mean± SD) days		2.66±1.24	N/A

The results showed that highest number of infants in the study group was on EFF 44.6%, followed by MF 36.9% and only 18.5% were on EBF. In contrast to that, control group had 50.8% infants on EBF, 35.4% on MF, and only 13.9 on EFF. A statistically significant association was found between the feeding type and the incidence of AGE ($p < 0.001$) as shown in Table 1.

Table 2
Comparison of Feeding Practices Between the Study and Control Groups (n=130)

Feeding practices	Study group (n=65)	Control group (n=65)	p-value/χ^2
Exclusive formula feeding n (%)	29 (44.6)	9 (13.9)	<0.001/20.35
Mix feeding n (%)	24 (36.9)	23 (35.4)	
Exclusive breast feeding n (%)	12 (18.5)	33 (50.8)	

Infants who were on EFF had significantly higher odds of developing AGE (OR: 8.86), followed by those on MF (OR: 2.87), while EBF infants had the lowest risk, highlighting the protective effect of breast milk as shown in Table 3.

Table 3
Association between Feeding Type and Risk of AGE (n=130)

Comparison	Odds ratio (OR)	95% Confidence Interval (CI)	p-value
EFF vs EBF	8.86	3.26-24.01	< 0.001
MF vs EBF	2.87	1.20-6.88	0.03
EFF vs MF	3.09	1.19-8.03	0.01

These findings clearly demonstrate a strong association between the type of feeding and the likelihood of developing AGE in infants aging < 6 months. The infants who were on EBF had the lowest risk demonstrating the protective role of breast milk during early months of infancy.

DISCUSSION

The results of our study showed that highest number of infants in the study group were on EFF (44.6%), followed by MF (36.9%) and only 18.5% were on EBF in contrast to control group where this percentage was 13.9%, 35.4% and 50.8%, respectively. A statistically significant association was found between the feeding type and the incidence of AGE ($p < 0.001$). Infants who were on EFF had significantly higher odds of developing gastroenteritis (OR: 8.86), followed by those on MF (OR: 2.87), while EBF had the lowest risk. The findings of our study are aligned with the studies; especially those conducted in low to middle income countries (LMIC), on the protective effects of EBF and increased risk of AGE associated with both EFF and MF.

The impact of feeding practices on infant morbidity was studied by Sharma R et al. in India. The results showed that only 0.03% of the infants presented with AGE were on EBF. An alarming high percentage of 65.8% were on bottle feeding and the rest were on MF. The study clearly underscored the importance of promoting EBF to reduce the risk of infantile gastroenteritis.[14] Supporting these findings, Dimitrovska-Ivanova M and Zisovska E. aimed to evaluate the AGE in infants <6 months, with main focus on association of disease severity and feeding type. This study conducted in Macedonia showed that EBF significantly reduced the risk of Rotavirus infection OR= 0.0758, 95% CI (0.0071-0.8074). The study established a clear association of the number and severity of episodes of diarrhea, frequency of vomiting, frequency of fever, risk of dehydration and need for parental rehydration.[15] Similarly, Ali MKM compared the ratio of breastfeeding versus formula feeding among infants presented with AGE in Iraq. The results demonstrated significantly higher gastroenteritis rates in infants who were on EFF (77.2%) providing substantial evidence that breast feeding offers protection against gastroenteritis in infants.[16]

Adding to the regional data in this context, a study conducted in Pakistan by Shah SSH et al., feeding practices and overall nutritional profiles were investigated in infants and children under the age of 3 years admitted in the hospital due to AGE. The study reported that only 32% of these children were on EBF. Overall prevalence of AGE was seen mostly in infants who were not EBF during their infancy.[17] Consistent with these findings, Malik W et al. compared bottle feeding and the EBF in reducing the hospital admissions for AGE in infants <6 months. Among these infants admitted due to AGE 66% of boys and 60% of girls were on bottle feeding. This study conducted at Services hospital Lahore, therefore clearly demonstrated that EBF have a protective effect against AGE and nourish the infants compared to the formula feeding.[12]

On the basis of the available evidence, a review article by Mafokwane T et al. on GI infections has concluded that EBF lowers the risk of AGE and hospital admissions due to diarrhea in infants and young children.[18] The findings discussed above from studies conducted in different geographical backgrounds but mostly in LMICs strongly support the evidence that the use of formula feeding and lack of breast feeding lead to the frequently reported incidences of AGE among the infants in their first 6 months of life.

The limitations of our study include its single-center design. Moreover, potential confounding variables such as maternal education and residential status were not stratified to further analyze the outcomes.

CONCLUSION

A significant association is found between feeding practices and the AGE risk in infants aged ≤6 months. EFF showed the highest risk, followed by MF, while EBF provided optimal protection. This evidence further emphasizes the significance of promoting breastfeeding in mothers as an effective preventive measure against gastroenteritis in infants within the Pakistani healthcare context.

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