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INFANT FEEDING PATTERNS AND ITS IMPACT ON INFANT GROWTH AND HOSPITALIZATION RATE

Adeel Saleem[1], Ronika Farooq[2], Sana Arshad[3], Dr. Nasim Rafiq[4], Amjad Ali[*5], Ribqa Farooq[6]

[1,2,3]*BSN, Student, Shalamar Nursing College,*
[4]*Phd in Nursing, Associate Professor & Principal, Shalamar Nursing College,*
[*5]*MSN, Assistant Professor, Shalamar Nursing College,*
[6]*Nursing officer, Services Hospital, Lahore*

[1]adeelsaleem1999@gmail.com,[2] ronikafarooq@gmail.com,[3] sanasohail207@gmail.com
[4]nasimtarik@yahoo.com,[*5]amjadalikmu233@gmail.com, [6]ribqafarooq2@gmail.com

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Corresponding Author: *
Amjad Ali

Abstract

Background: *Infancy is a critical period characterized by rapid growth and development. The choice of feeding method whether breastfeeding, formula feeding, or complementary feeding has a significant impact on a child's health. Previous studies suggest that exclusive breastfeeding during the first six months of life supports optimal growth and development.*

Objectives: *To assess the difference among feeding patterns, measure the growth and determine the rate of hospitalization in infants with different feeding patterns.*

Method: *An analytical cross-sectional study was conducted in the Karol War rural community of Lahore, Pakistan, involving 189 mothers of infants aged 1–12 months, selected through convenience sampling. Mothers with co-morbidities, psychiatric conditions, surrogate births, or prior knowledge of breastfeeding were excluded. Data were collected using a modified questionnaire after obtaining informed consent. Analysis was performed using SPSS version 27, utilizing frequencies, graphical representations, and ANOVA with p less than 0.05.*

Results: *There is a significant difference between infant weight and feeding patterns, with bottle-fed infants showing higher weight gain (8.87 ± 2.345; p = 0.001). However, no significant difference was found in height (p = 0.219). A significant association was also observed between feeding patterns and hospitalization rates, with formula-fed infants having a higher mean hospitalization rate (2.77 ± 0.504; p = 0.001).*

Conclusion: *Most of the infants were breastfed, followed by those who received mixed feeding and bottle feeding. Furthermore, the study found that bottle feeding was associated with increased weight compared to other feeding patterns; however, it also showed higher hospitalization rates among infants, primarily due to gastrointestinal disorders. The study emphasizes the need for interventions to promote optimal health outcomes for both mothers and infants.*

INTRODUCTION

Infant feeding is a crucial source of nutrients and energy for children aged 6–23 months, meeting half or more of energy needs between 6–12 months and about one-third between 12–24 months (1). Human

Breast milk, sophisticated and remarkably diverse biological fluid, has evolved over centuries to nourish infants and safeguard them from disease as their immune system develops over time. (2). The WHO and UNICEF provide clear global guidelines regarding breastfeeding, emphasizing that after birth it is essential for all newborns to have immediate kangaroo's care with their mothers. This approach facilitates the initiation of breast feeding within the first hour after birth, a critical measure for promoting ideal breastfeeding habits during infancy period (3). Children were grouped by exclusive breastfeeding (EBF) duration: never or ≤3 months, 3–6 months, and full 6 months. Feeding patterns were tracked through follow-ups up to 24 months, with EBF defined as only breast milk from birth to six months (4).

Infant feeding patterns significantly impact a child's growth and hospitalization rates, with three main types of practices. Exclusive breastfeeding (EBF) involves giving only breast milk for the first six months, with no other food, drink, or even water, except for necessary medications or supplements (5).According to the WHO, Partial breastfeeding "a situation where the baby is receiving some breastfeeds but is also being given other food or food-based fluids, such as formula milk or weaning foods (6). Insufficient milk intake in breastfeeding neonates often goes unnoticed, leading to preventable hospitalizations and long-term neurodevelopmental issues. Optimal infant feeding, especially in the first two years, is crucial for reducing child mortality, preventing chronic diseases, and promoting healthy growth and development.(7)

Exclusive breastfeeding from 4 to 6 months reduces the risk of gastrointestinal infections. However, some researchers question recommending it for a full 6 months in developed countries, as breast milk alone may not meet infants' energy needs at that age (8). Limited data exist on nutritional risks in exclusively breastfed infants, while many mothers face challenges like short maternity leave and limited support. Early use of formula is often driven by societal and personal pressures.WHO recommends starting complementary feeding at 6 months, but feeding issues can complicate weaning (9). Understanding factors like location, maternal age, delivery mode, and cultural beliefs is vital to improving breastfeeding and infant nutrition in developing countries. (10). Infancy is a crucial period where feeding methods significantly impact a child's physical, cognitive development, and immune strength. Proper nutrition boosts immunity and reduces illness and hospitalizations, while poor feeding increases vulnerability to disease.

Material and Method

This analytical cross-sectional study was conducted over four months in the Karol War rural community near Baghbanpura, Lahore, Punjab, Pakistan, after obtaining permission for data collection. The study population comprised mothers of 1–12-month-old infants, regardless of their feeding method; exclusive breastfeeding, formula feeding, or mixed feeding. Using Cochran's formula with an anticipated frequency of 14.3%, a 5% margin of error, and a 95% confidence level (Z=1.96), the calculated sample size was 189. A non-probability convenience sampling technique was employed. Inclusion criteria included mothers aged 18–40 with infants of either gender aged 1–12 months, while those with medical or psychological issues, or using surrogate mothers, were excluded. Data was collected through a validated and reliable modified tool (CVI = 0.81, reliability = 0.78) consisting of two parts: a 13-question demographic section and a 7-question observational checklist covering infant feeding patterns, weight, height, BMI, and hospitalization causes. After receiving permission from the Council Nazim and obtaining informed consent, participants voluntarily completed the questionnaire with assurances of confidentiality and no associated risks. The data was analyzed using SPSS-27. Descriptive statistics were presented via frequency tables and graphs, while inferential statistics involved the Kolmogorov test to assess normality ($p > 0.05$). ANOVA was applied for comparisons across the three feeding groups (breastfeeding, mixed feeding, and bottle feeding) against two dependent variables, with significance set at $p < 0.05$. Additionally, a Chi-square test was used to examine the association between feeding patterns and mode of delivery, as both were nominal variables.

Results

Table No 1: Demographic variables of the Mothers			
		n	%
Age of mother at the time of pregnancy	16	21	11.1
	18	14	7.4
	25	62	32.8
	Above 30	92	48.7
Number of Abortions	0	117	61.9
	1	52	27.5
	2	20	10.6
No of Live births	1	54	28.6
	2	62	32.8
	3	45	23.8
	4	28	14.8
	Total	**189**	**100.0**
Analyzed by frequency (n) and percentage (%)			

The data shows that most pregnant women were above 30 years old (48.7%), with fewer in younger age groups. A majority (61.9%) had no history of abortion, while 27.5% had one and 10.6% had two. Most mothers had two live births (32.8%), followed by one (28.6%) and three (23.8%). Overall, women above 30 commonly had two children and no history of abortion.

Table No 2: The height and weight of the child observe under the research study				
Variables	**Mean**	**S.D**	**Max**	**Min**
Height of child in Inches	25.07	2.176	30	20
Weight of child in Kg	7.20	2.553	12	02
Analyzed by mean (x) and standard deviation (S.D)				

Table 2 presents the infants' height and weight data, showing a mean height of 25.07 inches (range: 20–30 inches) and a mean weight of 7.20 kg (range: 2–12 kg). Heights and weights varied widely, with 2 kg indicating underweight and 12 kg indicating overweight. Overall, infants aged up to one year generally measured between 20–30 inches in height and 2–12 kg in weight.

Figure 1:Study Participants family monthly income in Pakistani rupees

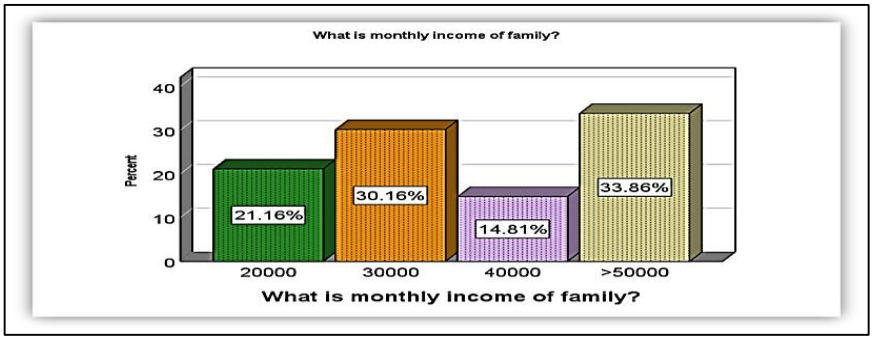
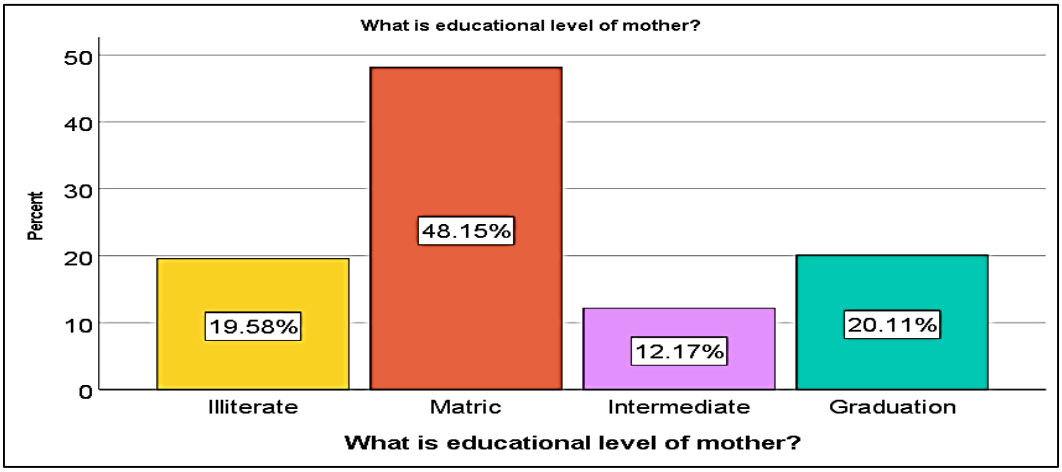


Figure 1 illustrates the monthly income of participants' families, with most earning above 50,000 (33.86%), followed by 30,000 (30.16%), 20,000 (21.16%), and 40,000 (14.81%). The data shows that the majority of families with children earn above 50,000, while the lowest reported income is 20,000.

Figure 2: Educational level of the mothers in the study



The bar chart shows the education level of mothers caring for infants: 48.15% were matriculated, 20.11% were graduates, 19.58% were illiterate, and 12.17% had completed intermediate education. Most mothers had matric-level education, with fewer graduates and illiterate mothers, and the least were intermediate passed

Table No.3: Observational variables of mother

		n	%
Mode of delivery	Normal Delivery	58	30.7
	C-Section	120	63.5
	Episiotomy	11	5.8
	Total	189	100.0
Complication at the time of pregnancy	Pre- Eclampsia	45	23.8
	Bleeding	14	7.4
	Abnormal Amniotic Fluid Volume Preterm Labor	15	7.9
	Gestational Diabetes	28	14.8
	Other specific	18	9.5
	None	69	36.5
	Total	189	100.0
Analyze by frequency 'n' and percentage "%"			

Table 3 shows that most mothers (63.5%) delivered via C-section, followed by 30.7% with normal delivery and 5.8% through episiotomy. Regarding pregnancy complications, 36.5% had none, while others experienced preeclampsia (23.8%), gestational diabetes (14.8%), other complications (9.5%), abnormal amniotic fluid or preterm labor (7.9%), and bleeding (7.4%).

Table no 4: Observational variables of mother			
		n	%
Mother drink alcohol	No	189	100.0
	Yes	0	0
Mother smoking	No	189	100.0
	Yes	0	0
Number of hospital visits during antenatal period	1-3	29	15.3
	4-7	17	9.0
	7-9	33	17.5
	More than 9	110	58.2
	Total	189	100.0
Analyzed by frequency 'n' and percentage "%"			

Table 4 shows that all 189 (100%) mothers did not consume alcohol or smoke during pregnancy. Regarding antenatal visits, the majority (58.2%) had more than 9 visits, followed by 17.5% with 7–9 visits, 15.3% with 1–3 visits, and 9% with 4–7 visits.

Table No 5: Demographic variables of study participants			
		n	%
Gender of infant	Male	114	60.3
	Female	75	39.7
	Total	189	100.0
Age of Child.	1-3 Months	63	33.3
	4-7 Months	47	24.9
	7-12 Months	79	41.8
	Total	189	100.0
Rank of child in siblings	The Eldest	48	25.4
	Middle	2	1.1
	Youngest	139	73.5
	Total	189	100.0
Analyzed by frequency 'n' and percentage "%"			

The table shows that most children (41.8%) were aged 7–12 months, followed by 33.3% aged 1–3 months, and 24.9% aged 4–7 months. Regarding sibling rank, 73.5% were the youngest, 25.4% were the eldest, and only 1.1% were middle children.

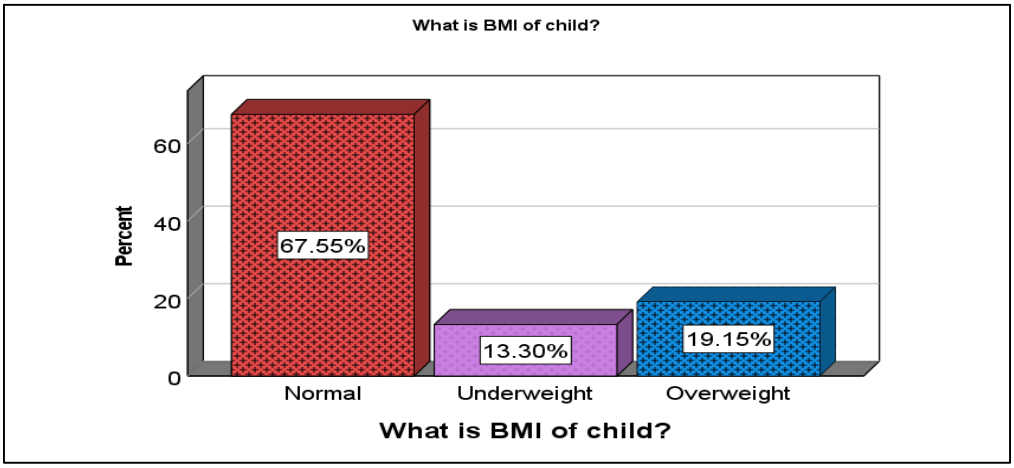


Figure 3: Body Mass Index of the Child

The bar chart shows that most infants (67.55%) had a normal body mass index, while 19.15% were overweight and 13.30% were underweight. Overall, the majority of infants had normal growth patterns, with fewer cases of underweight and overweight.

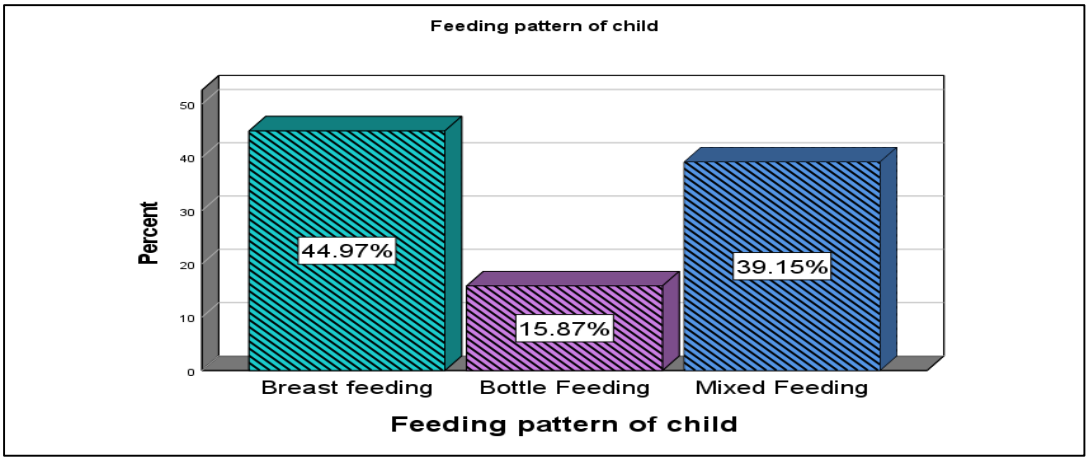


Figure 4: Feeding pattern of child; Breast feeding, Bottle feeding and Mixed Feeding

Figure 4 illustrates infant feeding patterns: 44.9% were breastfed, 39.15% received mixed feeding, and 15.87% were formula-fed. The majority of infants were on breastfeeding during infancy.

Table No 6: Observational variables of infant hospitalization rate and reason			
		n	%
Rate of hospitalization of child	1-3	64	33.9
	4-7	71	37.6
	7-9	42	22.2
	More than 9	12	6.3
	Total	189	100.0
Reason for Hospitalization of Child	GI disorders	84	44.4

	Respiratory disorders	51	27.0
	Any Other	2	1.1
	None	52	27.5
	Total	189	100.0
Analyzed by frequency 'n' and percentage '%'			

Table 6 shows that most infants (33.9%) were hospitalized 1-3 times, with fewer experiencing 4-7 (21.2%), 7-9 (22.2%), or over 9 (6.3%) hospitalizations. The leading cause of hospitalization was gastrointestinal disorders (44.4%), followed by respiratory issues (27%) and undocumented reasons (27.5%). This indicates that while many infants had few hospital visits, some faced frequent hospitalizations mainly due to GIT and respiratory problems.

Table No 7: Observational variables of infant reason for opting formula feeding of child			
		n	%
Reason of opting formula feeding of child	Milk Insufficiency	51	27.0
	Mother's Desire	32	16.9
	Medical Complications	21	11.1
	None	85	45.0
	Total	189	100.0
Reason for not opting formula feeding of child	Financial	23	12.2
	Mother's Desire	78	41.3
	Medical Complication	11	5.8
	Bonding and emotional connection	3	1.6
	None	74	39.2
	Total	189	100.0
Analyzed by frequency 'n' and percentage '%'			

Table 7 shows that 45% of mothers did not choose formula feeding, while 27% cited milk insufficiency, 16.9% preferred formula feeding, and 11.1% had medical complications. Reasons for avoiding formula included personal preference (41.3%), no specific reason (39.2%), financial issues (12.2%), and emotional bonding (1.6%). Overall, milk insufficiency and personal choice were key factors influencing formula feeding decisions.

Table No 8: Observational variables of infant not adherence and congenital abnormality			
		n	%
Reason of not adhering to the WHO recommendations of exclusive breastfeeding for the first six month	Lack of information and emotional awareness	22	11.6
	Cultural and Societal Norms	10	5.3
	Maternal Health Issues	71	37.6
	Pressure from family and peers	1	.5
	None	85	45.0
	Total	**189**	**100.0**
Child having any congenital abnormality	No	168	88.9
	Yes	21	11.1
	Total	**189**	**100.0**
Analyze by frequency 'n' and percentage '%'			

Table 8 shows that 45.5% of mothers adhered to exclusive breastfeeding for six months, while 37.6% faced maternal health issues, 11.6% lacked information or emotional awareness, 5.3% were influenced by cultural norms, and 0.5% experienced family pressure. Additionally, 88.9% of infants had no congenital abnormalities, but 11.1% did. This highlights that maternal health and knowledge gaps mainly affected breastfeeding adherence, with most infants healthy at birth.

Table No 09: Feeding Patterns association with infant Height					
		Height of child in inches			
Feeding Patterns	N	Mean	Std. Deviation	Std. Error	P-value
Breast feeding	85	24.72	2.452	0.266	0.219
Bottle Feeding	30	25.63	1.402	0.256	
Mixed Feeding	74	25.24	3.297	0.383	
Total	**189**	**25.07**	**2.707**	**0.197**	
Analyzed by one way ANOVA with P greater than 0.05					

The study's hypothesis on feeding patterns and infant growth shows that bottle-fed children had a higher mean height (25.63 ± 1.402) compared to mixed-fed (25.24 ± 3.297) and breastfed children (24.72 ± 2.452). However, the difference in height among these groups was not statistically significant, with a p-value of 0.219 (Table 9).

Table No 10: Feeding Patterns association with Infant weight					
		Weight of child in kg			
Feeding Patterns	N	Mean	Std. Deviation	Std. Error	P value
Breast Feeding	85	7.15	2.757	0.299	0.001
Bottle Feeding	30	8.87	2.345	0.428	
Mixed Feeding	74	6.66	2.131	0.248	
Total	**189**	**7.23**	**2.563**	**0.186**	
Analyzed by one-way ANOVA with a P less than 0.05					

The study hypothesis on feeding pattern and infant growth shows that bottle-fed children had a higher mean weight (8.87 ± 2.345) compared to breastfed (7.15 ± 2.757) and mixed-fed children (6.66 ± 2.131). There is a significant difference in weight among the three groups, supported by a p-value of 0.001, as shown in table 10.

Table No 11: Feeding Patterns association with infant Hospitalization rate					
		Infant Hospitalization Rate			
Feeding Patterns	N	Mean	Std. Deviation	Std. Error	P-value
Breast feeding	85	1.87	0.704	0.076	0.001
Bottle Feeding	30	2.77	0.504	0.092	
Mixed Feeding	74	1.86	1.077	0.125	
Total	189	2.01	0.905	0.066	
Analyzed by one-way ANOVA with a P less than 0.05					

The study hypothesis on feeding pattern and hospitalization rate shows that bottle-fed children had a higher mean hospitalization rate (2.77 ± 0.504) compared to breastfed (1.87 ± 0.704) and mixed-fed children (1.86 ± 1.077). A significant difference among the three groups is confirmed by a p-value of 0.001, supported by the clear difference in their means, as shown in the table 11.

Table No 12: Association between Feeding patterns and Mode of delivery

Feeding patterns	Mode of delivery			Total	P-Value
	Normal Delivery	C-Section	Episiotomy		
Breast Feeding	33 (39%)	52(61%)	0	85	0.000
Bottle Feeding	2(6%)	26(88%)	2(6%)	30	
Mixed Feeding	23(31%)	42(57%)	9(12%)	74	
Total	**58**	**120**	**11**	**189**	

Analyzed by chi –square with a P less than 0.05

The table 12 shows that among mothers who breastfed, 39% had normal delivery and 61% had C-sections, with no episiotomies reported. For bottle feeding, 88% had C-sections, 6% normal delivery, and 6% episiotomy. In mixed feeding, 57% had C-sections, 31% normal delivery, and 12% episiotomy. A significant association exists between mode of delivery and feeding pattern, indicated by a p-value of 0.000.

Discussion:

This study provides valuable insights into maternal and infant health characteristics, feeding patterns, and their associated outcomes. The majority of women in this research were around 30 years of age, with 48% reporting this age group, and most had two children (32%), which aligns with findings from Khalid Ahmed (2018), who reported that 74% of women aged 24 years had one to three children (11). The high prevalence of live births without complications in our study could be attributed to joint family settings, where pregnant women receive enhanced care, nutrition, and moral support from family members. Such support likely improves antenatal care utilization, which reduces abortion risk and promotes healthy births.

Financial status also showed significant relevance. Most parents earned above 50,000 annually, with the lowest incomes around 20,000. This trend corresponds with Jama et al.'s (2020) findings in Kenya, which indicated a positive association between higher income and exclusive breastfeeding (EBF).(12). Higher income likely increases access to information and healthcare, leading to better breastfeeding practices due to enhanced awareness and counseling by healthcare providers. This socioeconomic factor is critical because financial stability enables mothers to attend healthcare clinics and receive prenatal education, reinforcing breastfeeding benefits

Regarding maternal education, nearly half (48.15%) of mothers had education up to the matriculation level, while few were graduates, and some were illiterate. Most mothers had at least basic literacy, enabling them to comprehend infant feeding recommendations, thus promoting breastfeeding initiation and continuation. This finding supports Tian et al. (2019), who showed a positive correlation between higher maternal education and breastfeeding, although their cohort had a higher proportion of graduates (13). Arif and colleagues (2021) emphasize that in rural areas with low literacy, cultural misconceptions—such as viewing colostrum as stale milk and delaying breastfeeding—persist. These cultural practices expose infants to unsafe pre lacteal feeds (honey, glucose, butter), increasing infection risk (14).This is a risky practice because there is a significant chance of infection with these liquids.

An encouraging finding is that 100% of mothers reported abstaining from smoking or drinking during pregnancy, likely reflecting cultural and religious norms. Most mothers (58.2%) attended over nine prenatal consultations, mirroring Jama et al. (2020), who linked prenatal care with increased EBF rates. (12). These visits provide crucial education on infant feeding and care, enhancing maternal knowledge and improving neonatal outcomes

Regarding delivery methods, 63.5% of women underwent cesarean sections (C-sections), while 36.5% had uncomplicated pregnancies and vaginal deliveries. This high C-section rate parallels Wu et al.'s (2014) observation that China has one of the highest C-section rates globally (~40%). (15). The elevated rate in our study, even without apparent complications, suggests the need for further research to explore factors driving elective C-sections. Healthcare providers should promote normal deliveries to improve maternal and infant care quality, especially in rural settings where expanding healthcare service coverage and quality is essential

Infant gender distribution in this study favored males (60.3%) compared to females (39.7%), consistent with Khalil Ahmed's (2018) results but contrasting with Arif et al. (2021), where females predominated. Age-wise, 41.8% of infants were between 7 and 12 months, predominantly the youngest siblings, differing from Gale et al. (2012), who found a larger proportion of infants under 6 months (16).

Most infants had a normal body mass index (BMI) and healthy growth trajectories. Few were overweight, and underweight infants were the least common. This aligns with Eidelman's (2024) findings that bottle-fed infants often experience accelerated weight gain, which may predispose them to obesity later in life (17). Similarly, Camier et al. (2024) also found no lasting BMI difference linked to breastfeeding beyond infancy, though longer breastfeeding correlated with lower BMI at 1 year. Our study observed minimal differences among breastfed, mixed-fed, and formula-fed infants, possibly due to a higher proportion of breastfeeding mothers. However, further research is necessary to clarify feeding mode effects on growth and BMI (18).

Feeding patterns showed that 44.97% of infants were breastfed, consistent with Shiva and Nasiri (2003), who reported over 98% breastfeeding initiation shortly after birth. Arif et al. (2021) similarly noted that exclusive breastfeeding is common in Pakistan, emphasizing the need for health policies targeting demographic and social factors influencing breastfeeding to improve postnatal care quality (14).

Formula feeding was chosen by 27% of participants, primarily due to perceived milk insufficiency, with personal preference and financial constraints also contributing. This mirrors Motee et al. (2013), where 33.9% of formula users cited milk inadequacy. Our findings highlight the complexity of infant feeding decisions, influenced by biological, psychological, and socio-economic factors (19)

Regarding adherence to WHO recommendations for exclusive breastfeeding for six months, 45.5% of mothers complied, while 37.6% cited maternal health problems as the main barrier, followed by lack of information (11.6%) and cultural norms (5.3%). Only a small fraction (0.5%) felt pressured by family or peers. Zakar et al. (2018) similarly describe how maternal breastfeeding choices are influenced by social dynamics, resource availability, and societal expectations, often leading to feelings of helplessness among mothers when facing conflicting advice (20).

Significant differences were observed in infant weight based on feeding patterns (p=0.001), with bottle-fed infants weighing more than breastfed or mixed-fed counterparts. However, height differences were not significant (p=0.219). These findings agree with Xiaoli et al. (2019), who found feeding methods influenced weight but not height. Yao and Tang (2022) reported exclusively breastfed infants had higher weight and length at various ages compared to mixed-fed infants, suggesting feeding mode impacts growth differently across populations (21).

Hospitalization rates also varied significantly by feeding type (p=0.001), with bottle-fed infants experiencing more hospital visits than breastfed or mixed-fed infants. This aligns with findings by Zeeven Hooved et al., who link feeding patterns to health outcomes and hospitalization frequency. Gastrointestinal (GIT) disorders were the leading cause of infant hospitalization in our study, emphasizing the importance of gastrointestinal health during infancy. Breastfeeding is known to provide some protection against infections, though Shiva et al. (2007) note that breastfeeding reduces hospitalization for non-GIT infections but not gastroenteritis specifically (22).

Conclusion:

This study explored demographic and health factors affecting maternal and infant well-being. Most mothers were over 30, had C-sections, and received strong prenatal care. Infants were mainly male, aged 7–12 months, and predominantly breastfed. Bottle-fed infants showed higher weight and hospitalization rates, mainly due to gastrointestinal issues. The findings highlight breastfeeding's protective role and emphasize the need for maternal education and healthcare support in rural areas.

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