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Article

# Exploring the interplay of nutritional status, feeding practices and acute illness among infants under six months: A cross-sectional study

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**Abstract:** Malnutrition is a major public health concern and a major contributor to the worldwide burden of illness and mortality among children, with lower and middle-income countries bearing the heaviest burden. The current study aimed to determine the relationship of nutritional status (severe acute malnutrition, moderate acute malnutrition, stunting, wasting, overweight, and underweight) with feeding practices (e.g., colostrum feeding, breastfeeding type and frequency, and infant age when milk consumption was stopped) and acute illnesses (pneumonia, acute gastroenteritis, and upper respiratory tract infection) among six months or younger. A cross-sectional study design and purposive sampling were used to enroll 300 mothers and their seriously unwell among six months or younger infants. The data were analyzed using SPSS version 27, employing descriptive statistics and logistic regression analysis. The outcome of the study showed a higher prevalence of stunting (67.33%) than those of wasting (10%) and overweight (4.66%). Also, the findings showed ceasing milk consumption after 3–6 months can increase the risk of moderate acute malnutrition (odd ratio = 2.37, confidence interval = 1.04–5.39), with female infants having a lower risk of severe acute malnutrition, stunting, and being underweight, while upper respiratory tract infection can increase the risk of severe acute malnutrition in infants. Based on the findings, early nursing and exclusive breastfeeding for six months, followed by safe complementary foods, are recommended to improve newborn nutritional status.

**Keywords:** nutritional status; acute illness; feeding practices; infants under 05; stunting; wasting; overweight

## 1. Introduction

The prevalence of malnourished children globally has remained alarmingly high, especially in lower- and middle-income countries (LMICs) [1]. Malnourishment is regarded as a hidden epidemic that affects the youngest members of our population. Infant malnutrition is responsible for the increased frequency and severity of infections, which increases infant morbidity and mortality [2]. Malnutrition is defined as the lack of adequate food intake [3]. Lack of nutrients in an infant's diet can lead to life-threatening conditions, such as moderate acute malnutrition (MAM) and severe acute malnutrition (SAM), which are diagnosed based on anthropometric measures [4]. SAM presents a very low weight-for-height median score of more than 3 *z*-scores below the median of the World Health Organization (WHO) child growth standard, indicating wasting with or without the presence of nutritional edema. MAM is a less severe condition, in which the weight-for-height median score is more than 2 *z*-scores

below the median of the WHO child growth standards [5]. In Pakistan specifically, the prevalence of malnutrition, as indicated by a weight-for-height median score of more than 2 *z*-scores below the median of the WHO child growth standards for children under six months, is 15% [6]. According to the WHO, in 2020, it was estimated that five million children under the age of five died primarily from preventable and treatable causes. Approximately half of these fatalities, 2.4 million, occurred in the first 28 days of life among newborns [7].

As breast milk is an excellent source of nourishment for newborns, it is effective in reducing malnutrition. The WHO recommends exclusive breastfeeding in an infant's first six months. Infants should be fed safe and adequate complementary foods after six months, while continuing to be breastfed up to age two or older [8]. Maternal breast milk is a biological fluid that provides the most optimal nutrition for infants. Extensive evidence has shown that breast milk contains different types of lipids, proteins, carbohydrates, and antibodies. Besides its nutritional value, breast milk provides instant energy to infants, which is necessary for their neurodevelopmental, behavioral, and cognitive functioning [9]. Infant feeding practices are significantly correlated with overall infant health. Optimal infant feeding practices are crucial for the nutritional status, growth, development, health, and, ultimately, survival of infants and young children [10]. Exclusive breastfeeding practices in an infant's first six months have protective effects against acute illnesses, as breast milk protects infants from common infections and diseases [9]. Oligosaccharides present in breast milk stimulate the growth of microbiome in an infant's gastrointestinal tract, and the antibodies present in the milk allow the infant's immune system to mature. Breast milk also inhibits the binding of pathogens and toxins to intestinal cells [11]. Undernutrition, on the other hand, suppresses infants' immunity, which increases their susceptibility to infection and the severity of the disease. Recent studies have developed the concept of a vicious cycle between undernutrition and acute infections, where malnutrition is the primary factor that increases susceptibility to infections, and the subsequent impact on long-term health outcomes leads to increased morbidity and mortality [12].

To break this vicious cycle and improve the health of afflicted infants, it is essential to simultaneously address undernutrition and infectious diseases. Using contaminated water and liquids instead of breastmilk predisposes infants to vulnerable infections [13,14]. Despite a vast amount of research on infant feeding practices and poor breastfeeding rates, these practices remain major causes of malnutrition among infants in LMICs. The current study aimed to assess the prevalence of malnutrition and its effects by identifying the nutritional status and its association with feeding practices. The study included feeding behaviors, explicitly focusing on many elements of breastfeeding, such as colostrum feeding, pre-feeding procedures, if the infant was ever breastfed, current breastfeeding status, breastfeeding cessation, frequency of breastfeeding, introduction of other liquids, and infant's age when the liquid was introduced. Feeding practices such as non-exclusive breastfeeding have been reported to have a higher risk of fever in infants than exclusive breastfeeding [15]. Additionally, bottle feeding, breastfeeding, and the introduction of complementary feeding at six months were reported to be associated with a healthier nutritional status, such as

reduced odds of stunting from the introduction of complementary feeding at six months. However, bottle feeding was reported to increase stunting odds, but breastfeeding was reported to decrease the odds of infants being underweight [16]. Similarly, overdue initial breastfeeding and deficiency from colostrum are considered to cause a high risk of undernutrition for infants under age five.

Furthermore, the study included acute illnesses, such as pneumonia, acute gastroenteritis (AGE), and upper respiratory tract infection (URTI). Acute illnesses are considered a leading cause of low nutritional status. Studies have reported the high prevalence of malnutrition among infants with pneumonia. Also, stunting increases the risk of longer recovery among infants with pneumonia [17]. Additionally, a significant association between malnutrition and acute respiratory infection was reported [18]. Males under age five are at high risk of being underweight, stunted, and wasted as compared with females under age five. A high prevalence of stunting, wasting, and being underweight was reported among infants whose mothers are illiterate [19]. A high prevalence of malnutrition was reported among populations with a lower socioeconomic status. The occurrence of stunting is linked to maternal education, family size, and sanitation facilities, while wasting is found to be associated with male infants, food shortages, and children from urban areas. Similarly, the underweight status of children is linked to the lack of access to treated water, insufficient immunization, and the male gender [20].

### 1.1. Objective

The purpose of this study was to evaluate the association of nutritional status with acute illnesses and feeding practices among infants younger than six months of age.

## 2. Methodology

### 2.1. Research design and setting

This was a cross-sectional descriptive study. The study was conducted at the Outpatient Departments (OPDs) of Ruth Pfau Civil Hospital Karachi and Dow University Hospital in Karachi, Pakistan.

### 2.2. Inclusion criterion

The inclusion criterion was infants six months or younger age who were admitted to the OPDs of Ruth Pfau Civil Hospital Karachi and Dow University Hospital between 1 February 2020 to 31 April 2020.

### 2.3. Exclusion criteria

The exclusion criteria were infants who were admitted due to any traumas, poisoning, congenital diseases, or chronic illnesses, as well as infants who were admitted more than twice due to any illnesses, which indicated chronic illness.

### 2.4. Sampling technique

All infants fulfilling the eligibility criterion were enrolled through purposive sampling; here, infants under six months of age who had an acute illness were selected

as participants. This method allowed the researchers to focus on recruiting infants who fit the inclusion criterion for data collection relevant to the research goals.

## 2.5. Study duration

This study was conducted across three months from 1 February 2020 to 31 April 2020.

## 2.6. Sample size estimation

Using the prevalence of malnutrition of 15% among infants six months or younger in Pakistan based on a weight-for-height median score of more than 2 z-scores below the median of the WHO child growth standards, as well as an absolute precision of 5%, and a confidence interval of 95%, a sample size of more than 300 was determined using statistical tool OpenEpi. Overall, the targeted population of the study was infants six months or younger who were admitted to the OPDs of Ruth Pfau Civil Hospital Karachi and Dow University Hospital. Initially, a total of 403 infants six months or younger who fit the specified criterion were identified and their mothers were contacted. Out of these, the mothers of 13% declined to take part in the study, leaving a final sample size of 300 infants who were successfully enrolled.

## 2.7. Study parameters

Anthropometric measurements were obtained to evaluate the nutritional status of the infants. The infants' weight was measured with a preference for minimal or no clothing during the weighing process using a Seca 354 digital scale. The infants' length was determined by placing them horizontally on a ShorrBoard® portable heigh/length measuring board. Occipital frontal circumference was assessed using a non-stretchable tape around the widest part of the head, typically above the eyebrows and ears, ensuring that the tape was snug but not tight. Mid-upper arm circumference (MUAC) was also measured, which involved identifying the midpoint between the shoulder and the elbow on the upper arm, where subsequently a flexible, non-stretchable UNICEF MUAC tape was placed around this midpoint and the recorded measurement in centimeters was documented. Hence, the measurements encompassed infants' weight, length, mid-upper arm circumference, and head circumference.

## 2.8. Ethical considerations

After approval from the Scientific Committee and Institutional Review Board (approval IRB-1511) of Dow University and Health sciences (DUHS), participants were approached at the Pediatric Departments of Ruth Pfau Civil Hospital Karachi and Dow University Hospital. Infants six months or younger who were admitted to tertiary care and attended the OPDs of the hospitals were identified, and their mothers were approached for participation in the study. Infants who met the inclusion criterion were enrolled in our study. Informed consent was taken from each infant's mother. The mothers were briefed about the study and were assured that their information would be kept confidential.

### 2.9. Data collection

This study's data were gathered through the use of a questionnaire. The questionnaire was divided into four parts: the first section contained information regarding the infant's acute illness and the second part contained information about the infant's nutritional health. The third section featured information about the feeding practice for the infant and the final section contained information about the socioeconomic status of the infant's family. The questionnaire utilized was an adapted version of a CDC questionnaire for acute illnesses, nutritional status, and feeding behaviors. The questionnaire is included in the Appendix section. Participation was purely voluntary and there was no monetary inducement for completing the questionnaire.

### 2.10. Statistical analysis

The measured values of height and weight were converted into nutritional status data, which were weight-for-age, height-for-age, weight-for-height, and body-mass-index-for-age using the WHO Anthro Survey Analyser and then divided into five categories according to the WHO child growth standards: severe acute malnutrition (SAM), moderate acute malnutrition (MAM), stunting, wasting, overweight, and underweight. A mean and a standard deviation were used to describe the continuous characteristics of the variables, while categorical variables were described using frequency and percentage. Logistic regression was used to examine the association of nutritional status (dichotomous dependent variables) with feeding practices and acute illnesses. Similarly, the impacts of the mothers' demographics and socioeconomic status on nutritional status were investigated using logistic regression. The results of logistic regression were expressed in terms of the adjusted odd ratio (OR) with a 95% confidence interval (CI). A statistical significance was considered at $p < 0.05$. Statistical analysis was conducted using SPSS (Version 27).

## 3. Results

### 3.1. Infants' and mothers' characteristics

Overall, 300 infants were included in the study: among these, the majority were male (55%), while 45% were female. The mean age of the infants was 3.19 months, while their average weight and height were 4.63 kg and 54.6 cm, respectively. The average MUAC of the infants was 10.72 cm. A majority of the mothers (56.25%) were less than 25 years old. A large segment of the mothers were illiterate, while 21.3% had primary education. Most of the mothers in the study sample were housewives. Nearly three-quarters of the mothers were provided help during feeding. Similarly, most mothers received antenatal care (79.7%), and 59% of the mothers reported a monthly household income of less than PKR15,000 (USD54), as shown in **Table 1** below.

**Table 1**. Characteristics of infants and mothers.

| **Infant's characteristics** | *N* (%) or mean ± SD |
|---|---|
| Gender: | |
| Male | 165 (55) |
| Female | 135 (45) |
| Age | 3.19 ± 1.71 years |
| Weight | 4.36 ± 1.37 cm |
| Height | 54.6 ± 5.78 cm |
| MUAC | 10.72 ± 1.51 cm |
| Vaccination status: | |
| No | 39 (13.08) |
| Yes | 259 (99.61) |
| **Mother's characteristics** | *N* (%) or mean ± SD |
| Mother's age: | |
| <25 years | 168 (56.56) |
| 26–30 years | 67 (22.55) |
| 31–35 years | 45 (15.15) |
| >35 years | 17 (5.72) |
| Mother's education: | |
| Illiterate | 116 (38.7) |
| Primary | 64 (21.3) |
| Middle | 53 (17.7) |
| Secondary | 30 (10) |
| Intermediate | 7 (2.3) |
| Graduate | 24 (8) |
| Postgraduate | 3 (1) |
| Mother's occupation: | |
| Housewife | 287 (95.7) |
| Employed | 10 (3.3) |
| Help during feeding: | |
| No | 79 (26.51) |
| Yes | 219 (73.48) |
| Number of children: | |
| 1 | 61 (20.3) |
| 2 | 100 (33.3) |
| 3 | 71 (23.7) |
| >4 | 68 (22.7) |

**Table 1.** (*Continued*).

| **Mother's characteristics** | *N* (%) or mean ± SD |
|---|---|
| Antenatal care: | |
| No | 59 (19.7) |
| Yes | 239 (79.7) |
| Rank of child: | |
| First | 63 (21) |
| Second | 98 (32.7) |
| Third | 71 (23.7) |
| Fourth | 65 (21.7) |
| Fifth or more | 3 (1) |
| Mother's weight (kg) | 60.97 ± 1.82 |
| Mother's height (cm) | 157.83 ± 6.52 |
| Household monthly income: | |
| <PKR15,000 | 177 (59) |
| PKR 15,000–30,000 | 97 (32.3) |
| > PKR 30,000 | 26 (8.7) |

## 3.2. Nutritional status of infants under six months

Nutritional status was represented by stunting, wasting, overweight, underweight, SAM, and MAM. The average height-for-age was –2.83 ± 1.92, while the average weight-for-age was –2.67 ± 1.57 and the average weight-for-height was –0.58 ± 1.65. From the data, 8% of the infants had MAM and 10% had SAM. Additionally, 67.33% of the infants were classified as stunted and 10% were classified as wasted. Only 4.66% were overweight, while 54 infants, representing 18% of the sample, were classified as underweight (**Table 2**).

**Table 2.** Nutritional status of study sample.

| **Nutritional status** | ***N* (%) or mean ± SD** |
|---|---|
| SAM | 24 (8) |
| MAM | 30 (10) |
| Stunting | 202 (67.33) |
| Wasting | 30 (10) |
| Overweight | 14 (4.66) |
| Underweight | 54 (18) |
| Height-for-age | –2.83 ± 1.92 |
| Weight-for-age | –2.67 ± 1.57 |
| Weight-for-height | –0.58 ± 1.65 |

The distributions of height-for-age, weight-for-age, and weight-for-height in comparison to the WHO child growth standards are shown in **Figure 1**. As shown in the figure, the distributions of height-for-age are right-skewed for both male and female infants. Thus, the majority of infants' heights were lower than the WHO child growth standards, as the median scores of height-for-age were below the median of the WHO child growth standards. However, the weight-for-height z-score (WHZ) distribution of the female infants is nearly normally distributed, but with a lower peak. Meanwhile, he distributions of weight-for-age and body-mass-index-for-age for male is skewed to the right while for female it is slightly skewed to the left.

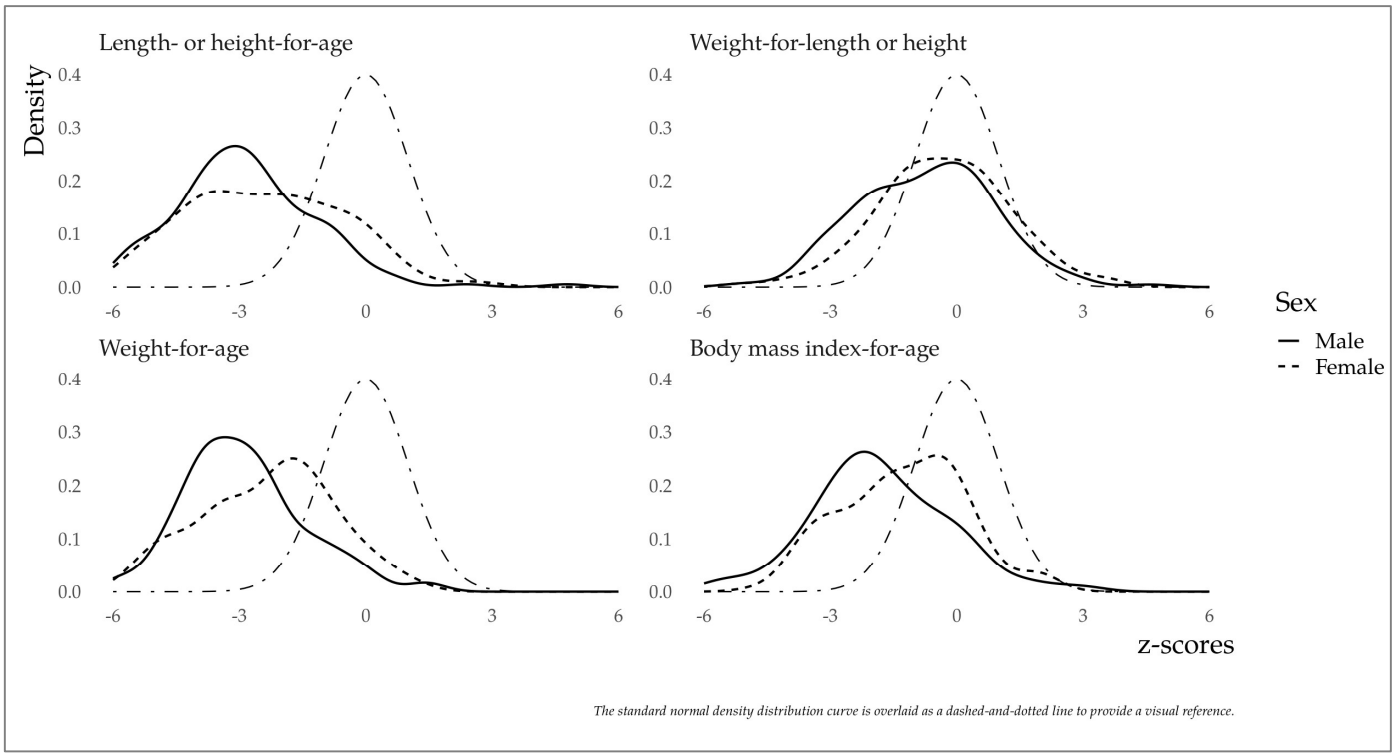


**Figure 1.** Nutritional status of study sample in comparison with WHO child growth standards represented by perfect bell curve.

A negative height-for-age *z*-score indicates a possible problem of growth stunting. A negative weight-for-height *z*-score indicates a propensity for a lower weight relative to height. Comprehending these measurements was essential for evaluating the general well-being and progress of the infants in the study. Additional examination and actions may be necessary to address potential issues connected to infant growth and promote the best possible development.

### 3.3. Prevalence of acute illnesses among infants of six months

Among the 300 infants, 47.33% had difficulty breathing. Three-quarters of the infants had a fever, 37.33% had a cough, and 33.33% had loose stools. Moreover, 28.33% of the infants were vomiting and 7.33% of infants were lethargic. Also, 36% of infants were diagnosed with pneumonia, 37% were diagnosed with AGE, and 12.3% of the infants were diagnosed with URTI (**Table 3**).

**Table 3.** Prevalence of acute illnesses among study sample.

| **Acute illness** | ***N* (%)** |
|---|---|
| Difficulty breathing | 142 (47.33) |
| Fever | 226 (75.33) |
| Cough | 112 (37.33) |
| Loose stools | 100 (33.33) |
| Lethargy | 22 (7.33) |
| Vomiting | 85 (28.33) |
| Fits | 20 (6.66) |
| Jaundice | 16 (5.33) |
| Anemia | 11 (3.66) |
| Pneumonia | 108 (36) |
| Paracoccidioidomycosis | 5 (1.66) |
| AGE | 111 (37) |
| Otitis media | 16 (5.33) |
| Malaria | 12 (4) |
| Meningitis | 7 (2.3) |
| Neonatal jaundice | 21 (7) |
| URTI | 37 (12.3) |
| Viral infection | 5 (1.7) |

## 3.4. Prevalence of feeding practices among infants of six months

More than 79.7% of the infants were provided colostrum, 43.33% of infants were provided honey, and 19.66% were provided *Kehwa* (green tea with spices) before breastfeeding started. Additionally, 90.33% of infants had been breastfed, while 78.66% were still breastfed at the time of the study. About 19% of infants stopped breastfeeding between 3–6 months due to insufficient breast milk (17.3%), their mother returning to work (1.3%), and their mother's illness (0.3%). In addition, 9.66% of infants were breastfed within their first hour. Regarding the type of breastfeeding47.66% practiced breastfeeding, 32.66% practiced exclusive breastfeeding, and 17.66% received formula milk. The majority of infants (46%) were breastfed more than eight times per day. Moreover, 54% of infants were introduced to other liquids within their first month, with water most commonly used for dilution (52.66%). Additionally, 60.66% of infants were fed using a bottle, and 16.66% of infants were fed semi-solid food (**Table 4**).

**Table 4.** Prevalence of breastfeeding practices among study sample.

| **Breastfeeding status** | ***N* (%)** |
|---|---|
| Colostrum feeding | 239 (79.7) |
| Fed anything before breastfeeding | 217 (72.33) |
| Honey | 130 (43.33) |
| *Ghutti* | 37 (12.33) |
| *Kehwa* | 59 (19.66) |
| Dates | 1 (0.33) |
| Ever breastfed | 271 (90.33) |
| Currently breastfed | 236 (78.66) |
| If no, when stopped: | |
| 0–3 months | 3 (1) |
| 3–6 months | 57 (19) |
| Why stopped breastfeeding: | |
| Insufficient breast milk | 52 (17.3) |
| Return to work | 4 (1.3) |
| Mother's illness | 1 (0.3) |
| If yes, fed within first hour | 29 (9.66) |
| If yes, breastfeeding type: | |
| Exclusive breastfeeding | 98 (32.66) |
| Breastfeeding | 143 (47.66) |
| Formula milk | 53 (17.66) |
| Animal milk | 3 (1) |
| How many times a day: | |
| <4 | 33 (11) |
| 4–8 | 73 (24.33) |
| >8 | 138 (46) |
| Liquid introduction month: | |
| 1 | 162 (54) |
| 2 | 25 (8.33) |
| 3 | 24 (8) |
| 4 | 9 (3) |
| 5 | 3 (1) |
| 6 | 1 (0.33) |
| Water | 158 (52.66) |
| Juice | 33 (11) |
| Tea | 40 (13.33) |
| Formula milk | 179 (59.66) |
| Honey | 7 (2.33) |
| Herbal medicine | 9 (3) |
| Sugar water | 14 (4.66) |
| Gripe water | 23 (7.66) |

**Table 4.** (*Continued*).

| **Breastfeeding status** | ***N* (%)** |
|---|---|
| Dilution: | |
| 1:1 | 176 (58.66) |
| 1:2 | 1 (0.33) |
| Type of water used for dilution: | |
| Boiled water | 116 (38.66) |
| Tap water | 6 (2) |
| Mineral water | 55 (18.33) |
| Method used to feed: | |
| Bottle | 182 (60.66) |
| Cup and spoon | 2 (0.66) |
| Preservation method if using animal milk: | |
| Boil | 10 (3.33) |
| Refrigerate | 2 (0.66) |
| Semi-solid food | 50 (16.66) |
| Porridge | 12 (4) |
| Fruit/vegetable puree | 34 (11.33) |
| Cerelac | 29 (9.66) |
| Other (Biscuit, Rice, cake etc.) | 23 (7.67) |
| Feeding stopped when infant was ill | 6 (2) |

### 3.5. Association of nutritional status with feeding practices and acute illnesses

The association between nutritional status and feeding practices was analyzed using logistic regression. The outcome is provided in **Table 5**.

**Table 5.** Association between nutritional status and feeding practices among study sample.

| | **MAM (OR (95% CI))** | **Overweight (OR (95% CI))** |
|---|---|---|
| Colostrum feeding | 0.82 (0.33–2.01) | 0.62 (0.18–2.05) |
| Fed anything before breastfeeding | 1.28 (0.53–3.12) | 0.95 (0.29–3.13) |
| Ever breastfed | 0.48 (0.17–1.39) | 1.41 (0.17–11.19) |
| Currently breastfeeding | 0.5 (0.22–1.13) | 1.66 (0.36–7.61) |
| Breastfeeding stopped after 3–6 months | 2.37 (1.04–5.39)* | 0.31 (0.04–2.46) |
| Insufficient breast milk | 1.52 (0.61–3.76) | 0.35 (0.04–2.77) |
| Exclusive breastfeeding | 1.42 (0.65–3.09) | 1.15 (0.37–3.53) |
| Breastfed more than 8 times a day | 1.38 (0.65–2.95) | 0.3 (0.08–1.11) |
| Breastfed 4–8 times a day | 0.59 (0.21–1.61) | 3.33 (1.12–9.84)* |

*$p < 0.05$

As per logistic regression from **Table 5**, the odds of MAM are 2.37 times higher if breastfeeding was stopped after 3–6 months ($p < 0.05$). Similarly, the odds of being overweight are 3.33 times higher for infants breastfed 4–8 times per day ($p < 0.05$).

From **Table 6**, among the infants' and mothers' characteristics, infant gender significantly impacts SAM ($p < 0.05$). The result indicates that the chances of SAM among female infants are 0.37 times lower than that of male infants. Additionally, gender and age significantly influence stunting; for example, the probability of stunting is 0.29 times lower for infants of higher age and for female infants, respectively ($p < 0.05$). Moreover, the significant impact of the mother's education is also reported. Thus, the odds of MAM among infants are 1.37 times higher if the mother's education level is high. Moreover, the probability of being underweight is 0.44 times lower for female infants than for male infants, while it is 1.3 times higher for infants whose mothers are educated.

**Table 6**. Association between nutritional status and characteristics of mothers and infants among study sample.

| Characteristic | SAM (OR (95% CI)) | MAM (OR (95% CI)) | Stunting (OR (95% CI)) | Overweight (OR (95% CI)) | Underweight (OR (95% CI)) |
|---|---|---|---|---|---|
| Mother's age in years | 1.03 (0.69–1.54) | 0.95 (0.62–1.45) | 1.02 (0.78–1.33) | 0.61 (0.26–1.42) | 0.99 (0.73–1.35) |
| Mother's education | 1.11 (0.82–1.5) | 1.37 (1.05–1.78)* | 1 (0.82–1.21) | 0.63 (0.37–1.07) | 1.3 (1.04–1.61)* |
| Mother's occupation | 0.65 (0.08–5.28) | 0.3 (0.04–2.26) | 0.74 (0.2–2.77) | 0.48 (0.01–17.41) | 0.39 (0.08–1.89) |
| Help during feeding | 0.86 (0.34–2.17) | 0.68 (0.29–1.58) | 1.08 (0.61–1.92) | 1.8 (0.49–6.6) | 0.74 (0.38–1.44) |
| No. of children | 1.43 (0.39–5.23) | 1.14 (0.2–6.4) | 3.48 (0.5–24.1) | 1.01 (0.07–13.28) | 1.41 (0.44–4.52) |
| Antenatal care | 0.68 (0.25–1.85) | 1.45 (0.49–4.24) | 1.2 (0.63–2.28) | 0.83 (0.24–2.85) | 0.97 (0.44–2.12) |
| Rank of child | 0.6 (0.16–2.2) | 0.89 (0.16–4.82) | 0.37 (0.05–2.45) | 0.78 (0.06–9.96) | 0.65 (0.2–2.06) |
| Mother's weight | 0.99 (0.94–1.03) | 0.98 (0.95–1.02) | 0.98 (0.95–1) | 1.01 (0.95–1.06) | 0.98 (0.95–1.01) |
| Mother's height | 1.01 (0.94–1.09) | 0.99 (0.93–1.06) | 0.99 (0.95–1.04) | 1.01 (0.92–1.12) | 1 (0.95–1.05) |
| Income | 0.74 (0.33–1.64) | 1.23 (0.63–2.41) | 0.78 (0.49–1.24) | 1.85 (0.72–4.74) | 0.98 (0.56–1.7) |
| Gender | 0.37 (0.14–0.98)* | 0.58 (0.25–1.33) | 0.29 (0.17–0.49)** | 1.84 (0.58–5.78) | 0.44 (0.22–0.84)* |
| Age | 1.01 (0.78–1.32) | 0.91 (0.71–1.16) | 0.77 (0.66–0.9)** | 1.18 (0.85–1.64) | 0.95 (0.79–1.15) |

* $p < 0.05$, ** $p < 0.01$

Furthermore, from **Table 7**, a significant impact of URTI is reported on SAM ($p < 0.01$). Thus, the odds of SAM are 3.15 times higher for infants with URTI. Besides this, no impact of other acute illnesses is reported.

Overall, the analysis suggests a higher prevalence of stunting than wasting, overweight, SAM, and MAM. Additionally, the study revealed that ceasing milk consumption after 3–6 months significantly increases the risk of MAM. Conversely, breastfeeding 4–8 times per day can lead to an infant being overweight. Also, according to the study outcome, female infants are at lower risk of SAM, stunting, and underweight as compared with male infants. In addition, URTI can create a high risk of SAM among infants.

**Table 7.** Association between nutritional status and acute illnesses.

| Acute illness | SAM (OR (95% CI)) | MAM (OR (95% CI)) |
|---|---|---|
| Pneumonia | 1 (0.22–4.52) | 2.82 (0.36–21.69) |
| AGE | 2.08 (0.47–9.19) | 1.19 (0.39–3.6) |
| URTI | 3.15** (1.3–7.63) | 0.95 (0.44–2.06) |

**$p < 0.01$

## 4. Discussion

The primary objective of the study was to find the relationship of nutritional status with feeding practices and acute illnesses among infants less than six months of age who presented acute illnesses and were admitted to tertiary care. The finding indicated suboptimal breastfeeding practices, with only 9.66% breastfed within their first hour of birth, in contrast to the global prevalence of 64% across 128 countries [21]. Our sample's early initiation rate was also lower than the national average in Pakistan, where 18% of mothers initiate breastfeeding early [22]. Mixed feeding was the predominant practice in our sample (47.66%), followed by exclusive breastfeeding (32.66%), mirroring the rates reported in the Multiple Indicator Cluster Survey (MICS) Sindh 2014, which documented 56% and 29%, respectively. In comparison with the 2018 demographic census, where breastfeeding prevalence was 46%, our study revealed a lower percentage. This difference may be attributed to variations in sampling methods, and this emphasizes the pivotal role of sampling strategies in influencing the representation of a population in a study or survey.

In our study, almost all of the mothers (91.33%) engaged in breastfeeding at some point, a figure consistent with similar studies in Sindh, Pakistan, reporting a rate of 95% [23]. In Pakistan, colostrum, which is the initial milk produced by a mother's breasts in the first few days after giving birth, carries cultural connotations. This yellowish, thick fluid, preceding the transition to mature breast milk, is often viewed as unclean and unhealthy for newborns [24]. However, in rural areas, efforts to reverse this perspective through education have been successful, with an increasing awareness of the benefits of colostrum. In our urban-centric study, where 75% of mothers resided in urban areas, 79.7% of infants were provided colostrum. This is contrary to the result of a previous research study of a sample in Rajanpur, Punjab Province, Pakistan, which indicated the persistence of traditional infant feeding practices that expose infants to potentially harmful substances, such as discarding colostrum and employing pre-lacteal feeding [25]. Our finding also revealed that 72.33% of the infants received pre-lacteal feeding, including honey (59%). Additionally, 16.66% of the participants reported using *Kehwa* either medicinally or as a beverage. *Kehwa* is a regional herbal drink with a history of consumption, typically made by boiling green tea leaves with spices, such as cardamom, cinnamon, and saffron. Moreover, 12.33% of the mothers utilized *ghutti*, an herbal paste traditionally employed to address various conditions, including infantile colic and digestive distress. This mixture involves grinding or combining herbs and spices with a binding agent, such as honey or ghee. In addition, a high to moderate prevalence of acute illnesses, such as difficulty breathing, fever, cough, loose stools, and vomiting, was reported in the study.

In our sample, 10% of infants were identified as having symptoms and signs of wasting. Within this group of malnourished neonates, 10% were categorized as moderately malnourished and 8% as severely malnourished. The study finding also indicated a high prevalence of stunting (67.33%), which is consistent with the WHO's estimated stunting prevalence of more than 40% among children under five years old [26]. It is important to note that these percentages pertain to an identical cohort of malnourished infants within our study population. Additionally, this estimated prevalence is higher than the 15% prevalence of malnutrition in infants under six months [6]. Moreover, the study outcome revealed a higher prevalence of stunting than wasting, overweight, SAM, and MAM among infants under six months.

In addition to exploring infant malnutrition rates, our study investigated the correlation between acute illnesses and the nutritional status of infants. The outcome revealed that ceasing milk consumption after 3–6 months significantly increases the risk of moderate acute malnutrition. This finding is consistent with studies that documented a high risk of undernutrition under age five due to overdue initial breastfeeding [16]. Similarly, the study finding revealed that breastfeeding 4–8 times per day can lead to an infant being overweight. In addition, the study outcome revealed that an increase in URTI can create a high risk of SAM among infants. In contrast to previous research findings, the result of this study did not provide any statistical evidence of the association of acute illnesses, such as AGE and pneumonia, with nutrition status, such as SAM and MAM ($p > 0.05$).

Overall, the findings emphasized the need for a swift and accurate diagnosis to commence malnutrition treatment. Also, according to the study outcome, female infants are at lower risk of SAM, stunting, and underweight as compared with male infants. Conversely, the study outcome suggested that male infants are at a higher risk of malnutrition, which is consistent with the studies by Kumar et al. and Ahmad et al., where males under five were documented as at a high risk of being underweight, stunted, and wasted as compared with females under five [19,20]. Interestingly, the study finding suggested that a mother's high level of education can increase the risk of MAM and underweight among infants. On the other hand, the study finding reported no association of maternal education and family size with nutrition status, such as stunting, wasting, and under/overweight. Overall, the findings emphasized starting breastfeeding and introducing complementary nutrition on time for infants.

## 5. Limitations

Obtaining precise birth weight and gastrointestinal age measurements posed challenges, potentially affecting the evaluation of undernutrition in an infant's first month. Consequently, the data may not precisely capture undernutrition during this period, which highlights the need for improved data collection and measurement for more accurate estimates. Therefore, the findings of this study should be approached with caution, and further research is warranted to gain a comprehensive understanding of early infancy undernutrition.

Furthermore, the study's reliance on anthropometric measures at a single point makes it difficult to interpret the nutritional status of infants under six months of age.

The lack of multiple measurements prevents the weight-for-height *z*-scores (WHZ) from serving as direct predictors of infant outcomes.

## 6. Conclusion

The findings highlighted a notable correlation between inappropriate feeding practices for neonates and the prevalence of malnutrition. Notably common findings were delayed initiation of breastfeeding, the use of pre-lacteal feeding, non-exclusive breastfeeding, and the early introduction of liquids and semi-solids within the first six months. These practices, particularly the non-exclusive breastfeeding, amplify the risk of diseases, such as acute gastroenteritis. The study revealed that the premature introduction of liquids and semi-solids before the recommended age of six months can contribute to this condition, thereby exacerbating the risk of infant malnutrition. In essence, the results suggested a connection between suboptimal feeding practices, the onset of acute illnesses, and the subsequent development of malnutrition.

## 7. Recommendations

In alignment with WHO recommendations, the study underscores that the primary strategy for enhancing the nutritional well-being of infants involves promptly initiating breastfeeding and exclusively breastfeeding for the first six months, followed by the introduction of complementary nutrition for a minimum of two years. It is imperative to reinforce existing nutrition programs targeted at informing mothers about the advantages of breastfeeding and identifying early signs of malnutrition in infants under six months. Healthcare providers play a crucial role in educating mothers about optimal infant feeding practices, and antenatal counseling on feeding practices can significantly contribute to this objective. Leveraging mass media can extend awareness not only to mothers but also to their entire family members. By implementing these strategies, it becomes possible to reduce the incidence of malnutrition in infants under six months. By implementing these initiatives, the incidence of malnutrition in infants under six months will be able to be decreased

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# Appendix A

Questionnaire: Measuring nutritional status, feeding practices, and acute illnesses among infants aged 1–6 months

| | | | | |
|---|---|---|---|---|
| Enrolment no: | | | | |
| Date of enrolment: | | | | |
| **Acute illness:** | | | | |
| Which of these are problems your baby has before coming to hospital? | Fever | | Loose stools | |
| | Vomiting | | Cough | |
| | RTI | | Lethargy | |
| | Other specify….. | | | |
| **Suspected initial diagnoses:** | | | | |
| Pneumonia | Anemia | Measles | PCM | |
| Pulmonary TB | Gastroenteritis | Enteric fever | Unknown | |
| Otitis media | Malaria | Febrile convulsions | Others | |
| **Anthropometric measures:** | | | | |
| Weight: | kg | Length: | ____ ____. ____ cm | |
| MUAC: | cm | Head circumference: | ____ ____. _____cm | |
| Edema | No edema | + | ++ | +++ |
| **Feeding practices:** | | | | |
| Colostrum given? | YES | NO | | |
| Any prelacteal food given? | YES | NO | | |
| If yes to prelacteal food, what was given? | Honey | *Ghutti* | | |
| | Dates | Others, specify: | | |
| Has your baby ever been breastfed? | YES | NO | | |
| Currently breastfeeding? | YES | NO | | |
| If currently NOT breastfeeding, age in months breastfeeding was stopped? | 0–3 m | | 3–6 m | |
| Reason for stopping breastfeeding? | Insufficient breast milk | | Fatigue | |
| | Return to work | | Others specify: | |
| | Mother' illness | | | |
| If YES, breastfeeding started within 1st hour of life? | YES | | NO | |
| If YES, breastfeeding type? | Exclusive breastfeeding | | Breastfeeding | |
| | Formula milk | | Animal milk | |
| If exclusive breastfeeding, how many times per day? | <4 times a day | | 4–8 times a day | |
| | >8 times a day other | | | |
| | 1 month | | 4 months | |

| | | |
|---|---|---|
| At what age did the infant first consume any liquids other than breast milk? | 2 months | 5 months |
| | 3 months | 6 months |
| | | N/A |
| What were the liquids given to the child other than breast milk? | Nothing | Formula milk |
| | Water | Soups |
| | Sweetened water | Honey |
| | Gripe water | Herbal medicine |
| | Juice | Cow's milk |
| | Soda/fizzy drinks | Others, specify…….. |
| | Tea/coca | |
| If formula milk, what dilution was used (water:milk)? | 1:1 | 1:2 |
| | 2:1 | |
| What type of water was used for diluting formula milk? | Boiled water | Mineral water |
| | Tap water | Other specify |
| What is used to feed the baby? | Bottle | Cup and spoon |
| Do you boil/sterilize bottle before feeding? | Yes | No |
| If yes to animal milk, how do you preserve it? | Boiling | Refrigerate |
| If yes to breastfeeding, other semi-solid foods consumed by infant before hospitalization | Porridge | Others |
| | Fruit/vegetable puree | |
| If yes, at what age did the infant first consume any semi-solids other than breast milk? | 1 month – 3 months | N/A |
| | 3 months – 6 months | |
| When the child fell ill, did mother stop breastfeeding? | YES | NO |
| If yes, what was given to the child instead? | Other liquids (water, animal milk, formula, soups, juices) | Semi-solids (porridge, fruit puree) |
| Vaccination given? | Yes | No |
| If yes, how many shots were given? | 1 | 2 |
| | 3 | 4 |
| **Socio-demographic data:** | | |
| Date of arrival at the hospital: | | |
| Child gender: | Male | Female |
| Age of child: | 1 month | 4 months |
| | 2 months | 5 months |
| | 3 months | 6 months |
| Address/Area | | |
| Mother's age (in years) | Less than 25 | 31–35 |
| | 26–30 | 36 or older |

| | | |
|---|---|---|
| Mother's education | Uneducated | Graduation |
| | Primary | Above Graduation |
| | Middle | |
| | Secondary | |
| Mother's occupation | Housewife | Employed |
| Does mother get any support while she breastfeeds the baby? | Yes | No |
| Mother's parity | 1 | 2–3 |
| | 1–2 | 4 or more |
| Antenatal care during last pregnancy | Yes | No |
| Mode of delivery | Normal delivery | Cesarean |
| | Assisted normal delivery | |
| Rank of this child | First | Second |
| | Third | Fourth |
| | Fifth or more | |
| Mother's weight in kg | | |
| Mother's height in cm | | |
| Household monthly income | Less than 15,000/- | More than 30,000 |
| | 15,000/- to 30,000/- | |