PJN
ISSN 1680-5194
ansinet.com/pjn

PAKISTAN JOURNAL OF NUTRITION

Science Alert
scialert.net

ANSInet
an open access publisher
http://ansinet.com

OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2024.1.12

Research Article
Risk Factors and Implications of Early Introduction of Complementary Feeding in Infants: A Case-Control Study in Peshawar, Pakistan

[1]Mir Shakir Ullah Jan, [1]Niamatullah, [2]Mir Amr Ullah Jan, [1]Zia Ud Din and [3]Mir Rooh Ullah Jan

[1]Department of Human Nutrition, University of Agriculture, Peshawar, Khyber Pakhtunkhwa, Pakistan
[2]Department of Medicine and Surgery, Ayub Medical College, Abbottabad, Khyber Pakhtunkhwa, Pakistan
[3]Department of Pediatrics, Hayatabad Medical Complex, Peshawar, Khyber Pakhtunkhwa, Pakistan

Abstract

Background and Objectives: The timely introduction of complementary feeding (CF) is crucial for infant health and development. Present study, conducted in Peshawar, Pakistan, aimed to identify risk factors associated with early CF initiation and its impact on infant health. **Materials and Methods:** A retrospective case-control study was conducted from July to October 2022 at Hayatabad Medical Complex vaccination center. A total of 800 mothers with infants of aged 6-12 months participated in this study. Participants were divided into early and timely introduction of CF groups, early CF was defined as the introduction of all liquid and solid foods, except breastfeeding and formula milk, before 6 months of age. **Results:** The study found that low maternal education, limited household income, young maternal age, and insufficient Antenatal care (ANC) visits were significant risk factors for early CF initiation. Infant behaviors such as excessive crying and frequent hunger episodes, along with maternal beliefs about the appropriate age of CF and paternal drug addiction, were also associated with early CF ($p<0.05$). Pearson correlation analysis indicated that the early introduction of CF had a considerable negative impact ($r = -0.408$) on infant nutritional status. **Conclusion:** These findings emphasized that CF practices in Peshawar must be improved through targeted public health interventions. Such interventions can improve infant health outcomes in the region.

Key words: Breastfeeding, complementary feeding, Hayatabad medical complex (HMC), infant feeding, infant health, risk factors

Citation: Jan, M.S.U., Niamatullah, M.A.U. Jan, Z.U. Din and M.R.U. Jan, 2024. Risk factors and implications of early introduction of complementary feeding in infants: A case-control study in Peshawar, Pakistan. Pak. J. Nutr., 23: 1-12.

Corresponding Author: Mir Shakir Ullah Jan, Department of Human Nutrition, University of Agriculture, Peshawar, Pakistan Tel: +923488077506

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The period from conception to a child's second birthday is often termed the "1000 golden days," a critical phase for their optimal health and development[1]. Nutrition during infancy significantly influences early growth[2]. The World Health Organization (WHO) strongly promotes exclusive breastfeeding for the initial six months, followed by complementary foods (CF), while continuing breastfeeding up to the age of two[3,4]. Several long-term studies align with WHO's guidelines, emphasizing the introduction of CF around the six-month mark[5,6].

Introducing complementary foods (CF) is pivotal for the healthy growth of infants. However, initiating this process too soon can potentially expose them to harmful microbes. Prematurely substituting breast milk with CF could result in the absence of crucial immune-protective elements present in breast milk[2,7]. Commencing CF before the age of six months might also influence the duration of breastfeeding[8,9]. Research indicates that infants' physiological readiness for CF prior to six months is limited due to the ongoing development of their gastrointestinal systems and kidneys[8,10]. A systematic review conducted in 2013 emphasized that early initiation of CF heightened the risk of childhood obesity[11].

Despite the well-documented risks to infant health linked to starting solid foods early, the initiation of complementary feeding (CF) before the recommended time is widespread across both developed and developing nations, going against guidelines from the World Health Organization (WHO)[12]. Research conducted across five European countries (Belgium, Germany, Italy, Poland, and Spain) revealed that approximately a quarter of infants begin the weaning process before they reach four months of age. Moreover, this study found that by the time these infants reach six months, at least 90% of them have already started consuming solid foods[13]. Prior Observational studies investigating CF in the South Asia context, which included Pakistan, India, Bangladesh, Nepal, and Sri Lanka, disclosed that more than half of the infants in these countries initiated CF before reaching the age of six months. Furthermore, when they reached the age of six months, at least 60% of these infants had consumed inappropriate foods[14-16]. Previous research conducted in developing countries has also indicated that current practices deviate from global WHO recommendations[15,18-20].

Various research contexts have pinpointed different factors that influence when mothers introduce CF. Studies in developed countries have associated early CF introduction with specific maternal characteristics such as age, education, occupation, marital status, socioeconomic status, pre-pregnancy body mass index (BMI), location of residence. Additionally, infant characteristics like birth weight, delivery method, birth order, and pacifier use have been linked to the timing of CF initiation[21,22]. On the other hand, there's a lack of comprehensive data concerning the factors impacting the age at which Pakistani mothers introduce solid foods, especially within the Peshawar district[15,17,19].

Peshawar, the ninth largest city in Pakistan with a population of approximately 1.97 million, faces a critical issue of limited evidence on breastfeeding and CF practices in the region. Despite their crucial importance in infant and child nutrition, CF practices have remained largely unexplored, hindering our understanding of factors influencing inappropriate practices, like early introduction of solid foods. This study aims to bridge this informational void by shedding light on CF practices in Peshawar and identifying key determinants. As a relatively understudied context, the lack of data in Peshawar offers a unique research opportunity with valuable insights for similar regions in other developing countries. Furthermore, this research can inform targeted community-level health interventions, promoting healthier CF practices and addressing issues related to child development. Cross-cultural comparisons with developed countries' studies enhance the study's impact and applicability, potentially leading to successful approaches adapted to the local context.

The main goals of this study were identifying the factors that responsible for the early introduction of CF among infants and to determine a connection between the age at which CF is introduced and the infant current nutritional status. The results of this research could offer valuable evidence to create strategies promoting proper CF in Peshawar. Since effective CF interventions should be customized to suit different populations with their varied circumstances and requirements, there's no fixed set of components for these interventions[22].

MATERIALS AND METHODS

This study was undertaken at the Vaccination Center of Hayatabad Medical Complex, Peshawar, during the time frame from July to October 2022. The study involved the collection of data pertaining to feeding practices over an approximate duration of 4 months.

This research was meticulously conducted and received ethical approval from the Human Research Ethics Committee (HN-HREC-2022-012) at the University of Agriculture Peshawar.

In this investigation, the participant pool consisted of mothers with infants falling within the age bracket of 6-12 months. Mothers with infants below the age of 6 months or surpassing the age of 12 months were deliberately

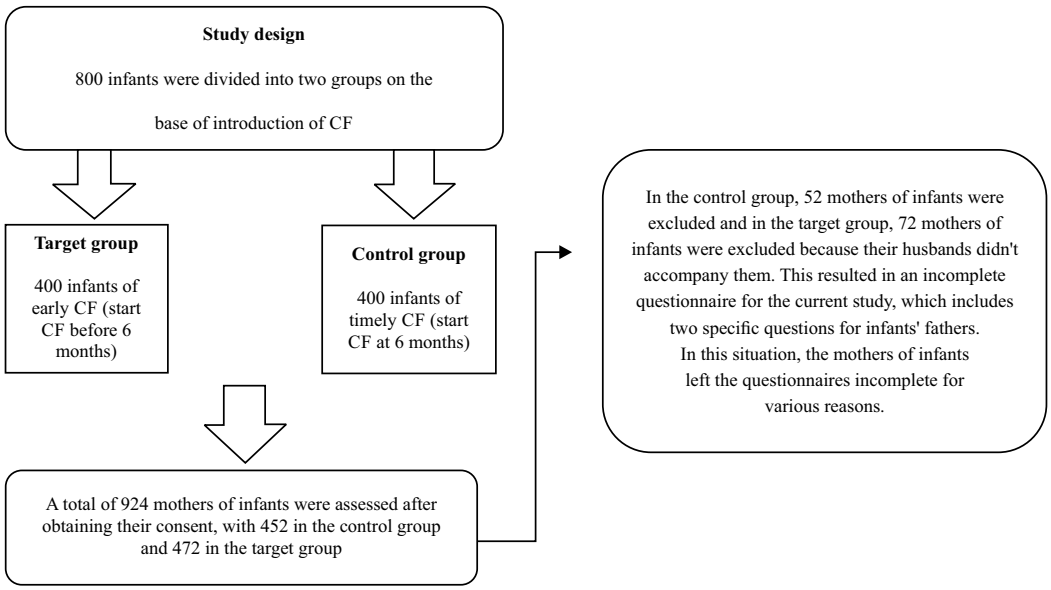

Fig. 1: Flowchart of the study

committed from the study's selection process. Data was collected at vaccination center after receiving approval from hospital administration. Based on the introduction of CF early or timely, the mothers of 800 infants were classified into two distinct groups in the present study using a retrospective case-control design. The two distinct groups were: The standard group (comprising infants following timely CF) and the target group (comprising infants practicing early CF). The sample size was determined using Cochran's formula[23]. The formula used was:

$$n = \frac{Z^2 \times p \times q}{e^2}$$

where, n represents the required sample size, p signifies the expected prevalence of timely CF (assumed as 0.50), q stands for the rate of early CF (also assumed as 0.50), e denotes the level of precision (set at 0.05), Z is the statistical value corresponding to a 95% confidence level (which is 1.96).

Upon plugging in these values, the calculated sample size was determined to be 384. Data was collected from infants' mothers after their consent through closed-ended questionnaires that were based on existing literature with some modifications. Figure 1 shows the flowchart of the study.

Data collection: The data for this study was obtained from a sample of 800 mothers of infants. The mothers themselves served as the primary respondents during the data collection process. A structured questionnaire was used to interview these mothers, which was originally created in English and then translated into Urdu. After securing their consent, the mothers received a hard copy of the questionnaire. In certain scenarios, face-to-face interviews were conducted with the mothers as an alternative to distributing the questionnaires. This approach was adopted due to the mothers' limited education level. Data collection continued until responses from 800 samples were obtained, resulting in a 100% response rate. The participating mothers provided their responses to the structured questionnaires with the assistance of trained and experienced interviewers. Questionnaires were designed to collect information about the mothers' historical practices of feeding their babies. This encompassed various aspects, such as the types of food initially offered to their babies and the precise timing of introducing complementary foods to their little ones. Additionally, two questions were asked regarding the precise timing of introducing CF and the presence of drug addiction in infant fathers. Questionnaires were provided to the infants' fathers after obtaining their consent. Face-to-face interviews were conducted with fathers with limited education who were unable to fill out the questionnaire.

The interviewers collected anthropometric information from mothers after they completed the questionnaires. The weight of infant was measured using a Salter scale and recorded in grams. Additionally, the length of the infants was measured in centimeters using a recumbent scale. The Z-score for each infant was then calculated based on their current weight and length measurements. This Z-score was utilized to

evaluate the nutritional health of the child, indicating whether their growth was within a healthy range. To compute the Z-score, AnthroPlus software was used, which provided a standardized assessment of the infants' measurements. Parents, infants, and families were explored through a variety of questions. In particular, it sought to collect information regarding the demographic background of the parents, such as their educational achievements, monthly household income, maternal employment status, family structure, availability of counseling for CF participants, maternal age, parity, and antenatal care visits during the last pregnancy. Additionally, the study aimed to capture data pertaining to the biological characteristics of infants, including gender, mode of delivery, gestational age, and birth weight. Furthermore, the study aimed to explore the behavior exhibited by infants prior to the initiation of CF, such as excessive crying and increased hunger.

Further, it investigated psychosocial factors affecting mothers, including their beliefs about the appropriate timing of CF, family planning, reasons for insufficient milk production, maternal illness and maternal drug addiction. Lastly, the study assessed maternal depressive symptoms by employing the Edinburgh Postnatal Depression Scale as a means of measurement. Before administering the questionnaires to the entire sample of participants, a pilot study was conducted with 15 participating mothers. The purpose of the pilot study was to test the design of the questionnaire and make any necessary alterations based on feedback. The pilot study revealed that, on average, it took 20 min for participants to complete the questionnaire. It is important to note that the participants involved in the pilot study were not included in the final study sample.

Data analysis: A software SPSS 21 was used for conducting statistical tests. The data presented in Tables 1-3 were subjected to chi-square analysis in order to display, evaluation and observe differences between different variables. The multi-variate logistic regression technique was employed to establish the connection between the dependent variable (i.e., early introduction of CF) and independent variables. Variables with a $p<0.05$ were deemed significant factors contributing to the early introduction of CF. Previous research has already elucidated the connections between diverse parental attributes and factors pertinent to infants, along with their

Table 1: Demographic factors of the studied population (N = 800)

	Groups				
	Timely		Early		
Factors	No.	Percentage	No.	Percentage	p-value
Father education duration					
<10 years	90	22	150	38	0.003
≥10 years	310	78	250	62	
Household income per month					
<50000 Rs	68	17	60	30	0.030
≥50000 Rs	332	83	280	70	
Maternal education					
<8 years	120	30	204	51	0.004
≥8 years	280	70	196	49	
Maternal employment status <6					
Employed	40	10	136	34	<0.001
Not employed	360	90	264	66	
Maternal age					
<25 years	24	6	108	27	<0.001
≥25 years	376	94	292	73	
Family structure					
Nuclear	268	67	124	31	<0.001
Joint	132	33	276	69	
Parity					
1 child	136	34	232	58	<0.001
≥2 children	264	66	268	42	
Breast feeding counselling at health center					
Yes, available	188	47	96	24	<0.001
Not, available	212	53	304	76	
ANC visits during last pregnancy					
<4	60	15	244	61	<0.001
≥4	340	85	156	39	

Table 2: Biological and behavioral factors and factors and its impact on nutritional status of infants of the studied population (N = 800)

	Groups				
	Timely		Early		
Factors	No.	Percentage	No.	Percentage	p-value
Infant biological factors					
Gender					
Male	200	50	200	50	0.395
Female	200	50	200	50	
Delivery mode					
Normal	352	88	228	62	<0.001
Surgical	48	12	172	38	
Infant gestational age					
<37 weeks	12	3	8	2	0.398
≥37 weeks	388	97	392	98	
Infant weight at birth (g)					
<2500	62	15	90	23	0.041
≥2500	338	85	310	77	
Infant behavior's factors					
Infant was excessively crying					
Was crying excessively	164	41	350	88	<0.001
Was not crying excessively	226	59	50	12	
Remain hungry more often					
Yes, hungry more often	112	28	254	63	<0.001
Not hungry more often	288	72	146	37	
Correlation of the complementary age with current nutritional status					
Age				Z. score (weight for length)	
	Pearson correlation			-0.408	
	Sig			<0.001	

Table 3: Psychosocial belief factors of the studied population (N = 1600)

	Groups				
	Timely		Early		
Factors	No.	Percentage	No.	Percentage	p-value
Maternal psychosocial belief					
Maternal belief about appropriate age of CF					
Don't know the appropriate age for the introduction of CF	360	90	182	43	<0.001
Know the appropriate age for the introduction of CF	40	10	218	57	
Follow 2 years gap of family planning					
Yes	248	87	204	51	<0.001
No	52	13	98	49	
Mother drug addiction					
Addicted	56	14	136	34	<0.001
Not addicted	344	86	264	76	
Due to insufficient milk production					
Start CF due to Insufficient milk production	30	8	144	36	<0.001
Did not Start CF due to Insufficient milk production	370	92	256	64	
Due to maternal illness					
Start CF due to maternal illness	21	5	80	20	<0.001
Did not start CF due to maternal illness	379	95	320	80	
Maternal depressive symptoms					
≤10	368	92	282	71	<0.001
>10	32	8	118	29	
Father psychosocial belief					
Father belief about age of CF					
Don't know the appropriate age for the introduction of CF	228	82	180	45	<0.001
Know the appropriate age for the introduction of CF	72	18	220	55	
Father drug addiction					
Addicted	84	21	140	35	0.027
Not addicted	316	79	260	70	

association with the timing of introducing CF. As a result, the present study was conducted to extend the investigation of these associations. To accomplish this objective, a structured questionnaire was formulated, taking cues from existing literature and incorporating tailored modifications based on previous studies[14,16,20-22,24]. From the comprehensive analysis of these scholarly works, present study identified 23 specific factors that appear to heighten the probability of initiating CF at an earlier developmental stage. The demographic variables taken into consideration were as follows: Father's educational attainment (≤10 years versus >10 years), Monthly household income (<50000 versus ≥50000), Maternal educational attainment (<8 years versus ≥8 years), Maternal employment status (returning to work within 6 months after childbirth), Maternal age (<25 years versus ≥25 years), Family structure (Nuclear versus Joint), Parity (1 child versus ≥2 children), Availability of counseling for breast-feeding (available versus Not available) and Antenatal care (ANC) visits during the last pregnancy (<4 visits versus ≥4 visits). Additionally, several infant-related factors associated with early initiation of CF were identified, including gender (male versus female), mode of delivery (surgical versus normal), infant gestational age (<37 weeks versus ≥37 weeks), infant birth weight (<2500 g versus ≥2500 g), as well as infant behavior such as excessive crying (was crying excessively versus was not crying excessively) and increased hunger (Yes, hungry more often vs Not hungry more often). Furthermore, the maternal psychosocial beliefs regarding the timing of CF, and drug addiction was assessed by using closed-ended response choices. Similarly, the father's beliefs regarding the timing of CF and drug addiction were also confirmed by using closed-ended response choices (addicted vs not-addicted). Maternal depressive symptoms were compared based on a value threshold (≤10 versus >10). Multivariate logistic regressions were used to investigate the associations between each potential explanatory variable and the early introduction of CF.

RESULTS

Table 1 shows the demographic characteristics of the interviewed infant mothers for identification of factors associated with early initiation of CF. Data were collected from 800 infants' mothers.

Table 2 illustrates the biological and behavioral factors of infants and its impact on their nutritional status. Present study has established a significant ($p<0.001$) association between early initiation of CF and the occurrence of obesity, particularly a high weight-for-length ratio. Furthermore, this study showed that introduction of CF before 6 months poses a potential risk of obesity for the infant. Among infants who started CF before 6 months of age (data not shown in table), 8% were classified as underweight (Z-score <-2), 59% were within the normal weight range (Z-score ≤2) and 33% were categorized as overweight (Z-score >2). In contrast, the infants who initiated CF at 6 months, 3% were underweight, 92% were within the normal weight range, and 5% were considered overweight.

Parents' psychosocial beliefs regarding CF are shown in Table 3. If the score on the Eden Burg depression scale was greater than 10, the mother of the infant was considered to have depressive symptoms.

Table 4 shows the dietary practices and the timing of introducing various types of complementary foods to a sample of 800 infants. Significant numbers of infants were introduced to foods that are typically recommended to be delayed until a certain age. For example, many infants are given meat, milk, and baby food before the age of four months, which contradicts guidelines established by manufacturers. Fruits, on the other hand, were more commonly introduced between the ages of four to six months. Moreover, concerning trends emerged in the introduction of sweet beverages, chocolates, and sugar, with nearly half of infants receiving these items before they were four months old. Accordingly, these findings highlight the need to promote

Table 4: The timing of introduction of different types of complementary food (N = 800)

Types of food	<4 months (%)	At 4 and 5 months (%)	≥ 6 months (%)
Meat	20	27	32
Milk	23	29	18
Baby food manufacturer	22	39	52
Fruit	28	33	75
Potato/rice	34	42	67
Snack food/salt	13	25	35
Sweet beverages/chocolate/sugar	27	35	40
Frequency			
≤2	58	33	24
≥3	42	67	76

healthier infant feeding practices in the Peshawar region. Furthermore, the table highlights that in the study population, many infants were not receiving complementary foods as frequently as recommended, underscoring the need to improve infant nutrition. Overall, Table 4 offer crucial information for policymakers and healthcare professionals to address and enhance infant nutrition in the region.

Present study has identified associations between 14 factors and the early introduction of CF as shown in Table 5. After adjustment, the significant ($p<0.05$) factors were shown to be Household income below RS.50,000 (OR: 2.092, 95% CI: 1.493-2.932), maternal education level less than 8 years (OR: 2.333, 95% CI: 1.746-3.119), maternal employment status (employed) (OR: 4.636, 95% CI: 3.150-6.825), maternal age at child birth below 25 years (OR: 5.795, 95% CI: 3.629-9.252), absence of breastfeeding counseling (OR: 4.122, 95% CI: 3.070-5.535), fewer than four ANC visits (OR: 8.863, 95% CI: 6.308-12.454), surgical delivery mode (OR: 2.945, 95% CI: 1.138-7.621), birth weight below 2500 grams (OR: 2.190, 95% CI: 1.496-3.206), infants excessively crying (OR: 2.681, 95% CI: 2.012-3.571), infants being hungry more often (OR: 4.378, 95% CI: 3.250-5.899), maternal belief of CF initiation without knowing the exact time (OR: 11.930, 95% CI: 8.143-17.480), initiating CF due to insufficient milk production (OR: 3.275, 95% CI: 1.297-8.267), initiating CF due to maternal illness (OR: 3.391, 95% CI: 1.218-9.438) and fathers being addicted to drugs (OR: 2.026, 95% CI: 1.476-2.780). In addition to providing insight into the impacts of these factors on the studied outcome, these odds ratios and confidence intervals can also help quantify their significance.

DISCUSSION

According to this study, nearly half of the infants consumed snack food and salt before reaching six months of age, contrary to recommendations for delaying such introductions (i-e sugar and salt) until the age of two years[25]. This observation further underscores the implications of premature food introduction. The study also demonstrated a significant association between the age of CF initiation and infants' nutritional status, revealing a strong negative correlation (Pearson correlation of -0.408, $p<0.001$) between the age at which CF was introduced and the infants' nutritional status. This negative correlation implies that as the age of CF initiation decreases (i.e., introducing CF earlier), the risk of elevated nutritional status increases. Current study further highlighted (data not shown in the table) the impact of early CF initiation on infant weight. A significant portion (33%) of infants who started CF before the recommended age of 6 months were overweight, whereas only 5% of those who began CF at 6 months were overweight. A previous cross-sectional study also revealed that inappropriate eating habits during infancy were linked to elevated nutritional levels in children[26]. Additionally, in line with previous research[27,28], this study confirms the association between infant obesity and early CF initiation.

According to this study, 57% of infants among the target group were introduced to complementary foods before the age of 17 weeks while 29% were introduced between the age of 17 and 21 weeks and 14% were introduced to complementary foods between the age of 21 and 23 weeks. These findings showed that infant feeding recommendations of the World Health Organization (WHO) are not being followed widely in the country. In previous studies conducted in different regions of Pakistan, it has consistently been shown that more than 50% of infants are given solid foods before they reach 6 months of age[18,19,29].

The present study has identified associations between 14 factors and the early introduction of CF. Current study has evaluated the relationship between low income and maternal employment status. Mothers from low-income families who returned to employment within six months after childbirth were more likely to introduce CF at an early age. The linked between low house hold income and early initiation of CF were also reported in earlier studies in Pakistan[14,29]. Regarding maternal employment, the present study aligns with previous research[30-32], which found a negative association between maternal employment status and early initiation of CF. In developing nations like Pakistan and India, early CF was more common among working mothers. Working mothers in Pakistan need access to information and support programs in order to reduce the number of mothers who introduce CF early, especially those with low incomes.

The latest research has found that mothers residing in low-income households and undergoing surgical deliveries tend to initiate early CF in their children. Although, the relationship between caesarean births and early CF initiation remains inconclusive in previous studies[2,24,30,31], a comprehensive systematic review identified a noteworthy correlation between caesarean births and decreased breastfeeding rates[33]. This correlation, in turn, was linked to shorter breastfeeding durations and the premature introduction of solid foods. Results of the present study agree with the previous studies conducted in Pakistan[29,34] which

showed that low house-hold income is the responsible factor for early initiation of CF. It has been shown that a caesarean section delivery coupled with socioeconomic factors, such as living in a low-income household, contribute to the early introduction of CF, possibly impacting the health and nutrition of an infant. Further research is needed to better understand the underlying mechanisms and develop effective interventions to promote optimal infant feeding practices.

Complementary feeding was more likely to be introduced to infants at an early age by younger mothers, especially those under 25 years old and with low levels of education (less than 8 years). This observation aligns with the findings of previous studies[35-38], which reported a positive correlation between maternal age and the timing of CF introduction. Moreover, lower levels of maternal education were consistently associated with the early initiation of complementary foods, as indicated in Table 5. Similar results were reported in a cross-sectional study conducted in Pakistan, which found that lower maternal education plays a significant role in the premature introduction of CF[34]. Additionally, 78 studies conducted in developing countries have reported similar outcomes[39]. Several studies have shown that maternal age and education level both affect the early introduction of CF. In order to promote optimal infant feeding practices, policymakers and healthcare providers must consider these factors.

According to the present analysis, mothers who had limited access to antenatal care (ANC) and inadequate breastfeeding counseling were more likely to initiate CF at an early stage. These findings are consistent with an earlier study conducted in Karachi, Pakistan which revealed that mothers with a low number of ANC visits were more inclined to introduce CF at an early stage[34]. Regarding lack of breast-feeding counselling, the present study aligns with previous literatures[29,34], which found a negative correlation between the absence of breastfeeding counseling and the early introduction of CF. Furthermore, according to the present study, low birth weight is a significant factor contributing to the early introduction of CF. This conclusion is supported by the data presented in Table 5 and similar results were reported in previous cohort studies which showed that infants with

Table 5: Identified risk factors which are responsible for early introduction of CF among infants.

Factors	Multi-variate	
Demographic factors	OR	95% CI
Father education		
<10 years	0.388	0.138, 1.093
≥10 years	1	Ref 1
Household income		
<50000	2.092	1.493, 2.932
≥50000	1	Ref 1
Maternal education level		
<8 years	2.333	1.746, 3.119
≥8 years	1	Ref 1
Maternal employment status <6 months		
Employed	4.636	3.150, 6.825
Not Employed	1	Ref 1
Maternal age at child birth (years)		
<25	5.795	3.629, 9.252
≥25	1	Ref 1
Family structure		
Nuclear	0.781	0.329, 1.852
Joint	1	Ref 1
Parity		
<1	1.654	0.791, 3.460
≥2	1	Ref 1
Breast feeding counselling		
Not available	4.122	3.070, 5.535
Available	1	Ref 1
ANC visits		
<4	8.863	6.308, 12.454
>4	1	Ref 1
Infant biological factor		
Gender		
Male	0.786	0.592, 1.038
Female	1	Ref 1

Table 5: Continue

Factors	Multi-variate	
Demographic factors	OR	95% CI
Delivery mode		
Surgical	2.945	1.138, 7.621
Normal	1	Ref 1
Gestational age		
<37 weeks	0.922	0.267, 3.181
≥37 weeks	1	Ref 1
Birth weight (g)		
<2500	2.190	1.496, 3.206
>2500	1	Ref 1
Infant behavior factors		
Excessively crying		
Infant was crying excessively	2.681	2.012, 3.571
Infant was not crying excessively	1	Ref 1
Hungry more often		
Yes, hungry more often	4.378	3.250, 5.899
Not hungry more often	1	Ref 1
Maternal psychosocial belief		
Maternal belief of CF		
Don't know the appropriate age for the introduction of CF	11.930	8.143, 17.480
Know the appropriate age for the introduction of CF	1	Ref 1
Follow 2 years gap of family planning		
No	0.820	0.174, 3.865
Yes	1	Ref 1
Mother drug addiction		
Addicted	2.107	0.911, 4.875
Not addicted	1	Ref 1
Due to insufficient milk production		
Start CF due to Insufficient milk production	3.275	1.297, 8.267
Did not Start CF due to Insufficient milk production	1	Ref 1
Due to maternal illness		
Start CF due to maternal illness	3.391	1.218, 9.438
Did not start CF due to maternal illness	1	Ref 1
Maternal depressive symptoms		
≤10	1	Ref 1
>10	0.492	0.194, 1.251
Fathers' psychosocial belief		
Father belief about CF		
Don't know the appropriate age for the introduction of CF	0.674	0.295, 1.537
Know the appropriate age for the introduction of CF	1	Ref 1
Father drug addiction		
Addicted	2.026	1.476, 2.780
Not addicted	1	Ref 1

low birth weight were more likely to experience early CF initiation[40,41]. According to this study, low birth weight, limited access to ANC and breastfeeding counseling play crucial roles in the early introduction of CF. Pakistan can improve infant health and nutrition outcomes by understanding and addressing these factors.

Mothers, particularly those with limited education, who introduced CF to their infants at an early stage often provided specific reasons for their choice. These reasons included their babies' excessive crying and more frequent hunger episodes. These mothers expressed concerns about having an insufficient milk supply to satisfy their baby's hunger or worries about their baby falling ill if they consumed breast milk when the mother was ill as shown as in Table 5. Similar results were reported in previous cross-sectional studies that have highlighted maternal misconceptions regarding the role of breastfeeding in the premature introduction of CF[21,24]. An independent cohort study conducted in Australia also confirmed these reasons among mothers who introduced CF at an early stage[37]. It is common for mothers to introduce CF early in response to concerns about infant hunger and health, which are often influenced by misconceptions and

lack of awareness about the benefits of exclusive breastfeeding. Addressing these concerns through education and support could contribute to improve infant feeding practices.

Furthermore, the present study reveals that many illiterate mothers are unaware of the appropriate timing for initiating CF in infants. Many mothers who introduced CF early had little knowledge of when to start it. According to the recent analysis, mothers without knowledge of the correct timing for CF initiation are more likely to introduce it prematurely (Table 5). Similar results have been reported in a cross-sectional analysis conducted in Pakistan, demonstrating that maternal low nutritional awareness is a risk factor associated with early CF initiation[29,34]. Furthermore, the current study has revealed that infants whose fathers have a history of drug addiction often exhibited social inactivity, which, in turn, had negative effect on the health of their infants. A comprehensive European review reported that infants with socially inactive fathers were more likely to experience early CF initiation[35].The lack of maternal awareness about the correct timing for CF initiation, coupled with paternal drug addiction, can contribute to the premature introduction of CF, emphasizing the importance of comprehensive education and support for both parents in promoting optimal infant feeding practices.

LIMITATIONS OF STUDY

When evaluating and interpreting the outcomes of this study, it is essential to consider several limitations. One primary constraint is the presence of unavoidable recall bias resulting from the retrospective nature of data collection. This bias may lead participants to either overestimate or underestimate the CF practices they have employed in the past. Another inherent limitation is the restricted scope of the research, as it solely involved mothers presenting at a government hospital. This exclusion of mothers attending other healthcare facilities, such as privately-run clinics, limits the generalizability of the findings. Mothers attending private clinics may belong to different socioeconomic classes, potentially leading to variations in their CF patterns and the factors influencing them. Furthermore, it is crucial to acknowledge that epidemiological studies, like the present one, cannot establish causality conclusively. While they can identify possible associations between variables, they cannot definitively determine cause-and-effect relationships.

CONCLUSION

Mothers with lower education levels, limited income, younger age, and fewer ANC visits are more likely to introduce CF before the recommended age of six months. Moreover, maternal employment status, excessive infant crying, frequent hunger episodes and paternal drug addiction were also linked to early initiation of CF. These findings have important implications for public health interventions aimed at improving infant nutrition in Peshawar. Addressing these risk factors through targeted educational programs and support systems for mothers, especially those with limited education and low income, could help promote optimal CF practices. In order to ensure timely CF introduction, mothers should be encouraged to attend ANC and to receive breastfeeding counseling. As the "1000 golden days" of early childhood are critical for a child's growth and development, it is essential to empower parents with accurate information and resources to make informed decisions about infant feeding. The insights gained from this study can inform the design and implementation of targeted interventions to promote healthier CF practices, leading to improved health outcomes for infants in Peshawar and similar settings. Moreover, these findings contribute to the broader understanding of factors influencing CF practices globally, thus providing valuable insights for designing effective interventions in diverse cultural and socioeconomic contexts.

REFERENCES

1. Kuriyan, R. and A.V. Kurpad, 2012. Complementary feeding patterns in India. Nutr. Metabol. Cardiovascular Dis., 22: 799-805.
2. Tang, L., A.H. Lee and C.W. Binns, 2015. Predictors of early introduction of complementary feeding: Longitudinal study. Pediatr. Int., 57: 126-130.
3. Qasem, W., T. Fenton and J. Friel, 2015. Age of introduction of first complementary feeding for infants: Aa systematic review. BMC Pediatr., Vol. 15, No. 107. 10.1186/s12887-015-0409-5.
4. WHO., 2003. Global Strategy for Infant and Young Child Feeding. World Health Organization Geneva. https://apps.who.int/iris/bitstream/handle/10665/42590/9241562218.pdf?sequence=1
5. Kramer, M.S. and R. Kakuma, 2012. Optimal duration of exclusive breastfeeding. Cochrane Database Syst. Rev., Vol. 1, 10.1002/14651858.CD003517.pub2.
6. Dewey, K.G., 2006. What Is the Optimal Age for Introduction of Complementary Foods? In: Nestlé Nutrition Institute Workshop Series. Minh, H.C. (Ed.), Karger, 15.

7. Victor, R., S.K. Baines, K.E. Agho and M.J. Dibley, 2014. Factors associated with inappropriate complementary feeding practices among children aged 6-23 months in Tanzania. Maternal Child Nutr., 10: 545-561.
8. Rao, S., P.M. Swathi, B. Unnikrishnan and A. Hegde, 2011. Study of complementary feeding practices among mothers of children aged six months to two years-a study from coastal South India. Aust. Med. J., 4: 252-257.
9. Kronborg, H., E. Foverskov and M. Vaeth, 2014. Predictors for early introduction of solid food among Danish mothers and infants: An observational study. BMC Pediatr., Vol. 14, No. 1. 10.1186/1471-2431-14-243
10. Kostecka, M., I. Jackowska and J. Kostecka, 2020. Factors affecting complementary feeding of infants: A pilot study conducted after the introduction of new infant feeding guidelines in Poland Nutrients, Vol. 13, No. 1, 10.3390/nu13010061.
11. Pearce, J. M.A. Taylor and S.C. Langley-Evans, 2013. Timing of the introduction of complementary feeding and risk of childhood obesity: A systematic review. Int. J. Obesity, 37: 1295-1306.
12. Michaelsen, K.F., L. Grummer Strawn and F. Bégin, 2017. Emerging issues in complementary feeding: Global aspects. Matern. Child Nutr., Vol. 1, 10.1111/mcn.12444.
13. Alvisi, P., S. Brusa, S. Alboresi, S. Amarri and P. Bottau *et al*., 2015. Recommendations on complementary feeding for healthy, full-term infants. Ital. J. Pediatr. Vol. 41, No. 36, 10.1186/s13052-015-0143-5.
14. Khan, G.N., S. Ariff, U. Khan, A. Habib and M. Umer *et al*., 2017. Determinants of infant and young child feeding practices by mothers in two rural districts of Sindh, Pakistan: A cross-sectional survey. Int. Breastfeed J., Vol. 12, No. 40, 10.1186/s13006-017-0131-z.
15. Senarath, U., K.E. Agho, D.E.S. Akram, S.S. Godakandage and T. Hazir *et al*., 2012. Comparisons of complementary feeding indicators and associated factors in children aged 6-23 months across five South Asian countries. Maternal Child Nutr., 8: 89-106.
16. Hanif, H., 2011. Trends in breastfeeding and complementary feeding practices in Pakistan, 1990-2007. Int. Breastfeed J., Vol. 6, No. 15, 10.1186/1746-4358-6-15.
17. Garg, A. and R. Chadha, 2009. Index for measuring the quality of complementary feeding practices in rural India. J. Health Popul. Nutr., 27: 763-771.
18. Ali, M., M. Arif and A.A. Shah, 2021. Complementary feeding practices and associated factors among children aged 6-23 months in Pakistan. PLoS ONE, Vol. 16, 10.1371/journal.pone.0247602.
19. Khokhar, S., H.A. Jatoi and Z.S. Lassi, 2017. Prevalence of timely introduction of complementary feeding and its related factors in children 6–24 months of age in Hyderabad, Pakistan. Nursing Midwifery Stud., Vol. 3,
20. Wang, L., A. van Grieken, L.A. van der Velde, E. Vlasblom, M. Beltman, M.P. L'Hoir, M.M. Boere-Boonekamp and H. Raat, 2019. Factors associated with early introduction of complementary feeding and consumption of non-recommended foods among Dutch infants: The BeeBOFT study. BMC Public Health, Vol. 19, 10.1186/s12889-019-6722-4.
21. Mrosková, S., A. Schlosserová and D. Magurová, 2016. Age of the introduction of the first complementary food and determinants of its early introduction by Slovak mothers. Cent Eur. J. Nurs. Midw., 7: 368-376.
22. Dewey, K.G. and S. Adu Afarwuah, 2008. Systematic review of the efficacy and effectiveness of complementary feeding interventions in developing countries. Matern. Child Nutr., 4: 24-85.
23. Ahmad, H. and H. Halim, 2017. Determining sample size for research activities. Selangor Bus. Rev., 2: 20-34.
24. Alzaheb, R., 2016. Factors associated with the early introduction of complementary feeding in Saudi Arabia. Int. J. Environ. Res. Public Health, Vol. 13, 10.3390/ijerph13070702.
25. Mis, N.F., C. Braegger, J. Bronsky, C. Campoy and M. Domellöf *et al*., 2017. Sugar in infants, children and adolescents: A position paper of the European society for paediatric gastroenterology, hepatology and nutrition committee on nutrition. J. Pediatr. Gastroenterol Nutr., 65: 681-696.
26. Bustos, A.E., C.M. Cádiz, A.K. Etchegaray and V.O. Castillo, 2021. Feeding behavior, dietary sufficiency and nutritional status in children between 6 and 18 months. Andes Pediatr., 92: 699-709.
27. Simon, V.G.N., J.M.P. de Souza and S.B. de Souza, 2009. Breastfeeding, complementary feeding, overweight and obesity in pre-school children. Rev. Saúde Pública, 43: 60-69.
28. Monteiro, P.O.A. and C. G. Victora, 2005. Rapid growth in infancy and childhood and obesity in later life: A systematic review. Obesity Reviews, 6: 143-154.
29. Liaqat, P., M.A. Rizvi, A. Qayyum and H. Ahmed, 2007. Association between complementary feeding practice and mother`s education status in Islamabad. J. Human Nutr. Diet., 20: 340-344.
30. Gardner, H., K. Green and A. Gardner, 2015. Infant feeding practices of Emirati women in the rapidly developing city of Abu Dhabi, United Arab Emirates. Int. J. Environ. Res. Public Health, 12: 10923-10940.
31. Batal, M., C. Boulghourjian and C. Akik, 2010. Complementary feeding patterns in a developing country: A cross-sectional study across Lebanon. East Mediterr Health J., 16: 180-186.
32. Shumey, A., M. Demissie and Y. Berhane, 2013. Timely initiation of complementary feeding and associated factors among children aged 6 to 12 months in Northern Ethiopia: An institution-based cross-sectional study. BMC Public Health, Vol. 13, 10.1186/1471-2458-13-1050.

33. Prior, E., S. Santhakumaran, C. Gale, L.H. Philipps, N. Modi and M.J. Hyde, 2012. Breastfeeding after cesarean delivery: A systematic review and meta-analysis of world literature. Am. J. Clin. Nutr., 95: 1113-1135.
34. Wijndaele, K., R. Lakshman, J.R. Landsbaugh, K.K. Ong and D. Ogilvie, 2009. Determinants of early weaning and use of unmodified cow's milk in infants: A systematic review. J. Am. Diet. Assoc., 109: 2017-2028.
35. Agostoni, C., T. Decsi, M. Fewtrell, O. Goulet and S. Kolacek *et al*., 2008. Complementary feeding: A commentary by the ESPGHAN committee on nutrition. J. Pediatr. Gastroenterol. Nutr., 46: 99-110.
36. Agedew, E., M. Demissie, D. Misker and D. Haftu, 2014. Early initiation of complementary feeding and associated factors among 6 months to 2 years young children, in Kamba Woreda, South West Ethiopia: A community-based cross-sectional study. J. Nutr. Food Sci., Vol. 4. 10.4172/2155-9600.1000314.
37. Scott, J.A., C.W. Binns, K.I. Graham and W.H. Oddy, 2009. Predictors of the early introduction of solid foods in infants: Results of a cohort study. BMC Pediatr., Vol. 4, 10.1186/1471-2431-9-60.
38. Doub, A.E., K.J. Moding and C.A. Stifter, 2015. Infant and maternal predictors of early life feeding decisions. The timing of solid food introduction. Appetite, 92: 261-268.
39. Krebs, N.F., K.M. Hambidge, 2007. Complementary feeding: Clinically relevant factors affecting timing and composition. Am. J. Clin. Nutr., 85: 6395-6455.
40. Mamemoto, K., M. Kubota, A. Nagai, Y. Takahashi, T. Kamamoto, H. Minowa and H. Yasuhara, 2013. Factors associated with exclusive breastfeeding in low birth weight infants at NICU discharge and the start of complementary feeding. Asia Pac. J. Clin. Nutr., 22: 270-275.
41. Fanaro, S., G. Borsari and V. Vigi, 2009. Complementary feeding practices in preterm infants: an observational study in a cohort of Italian infants. J. Pediatr. Gastroenterol. Nutr., 45: S210-S214.