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Discriminant Analysis of Infant Feeding Patterns Among Infants Aged 6–24 Months in Al-Aflaj Governorate, Saudi Arabia

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ABSTRACT: Breastfeeding (BF) is the safest option for feeding infants in the first six months of a baby's life. But their rates are still low globally. This necessitates developing evidence-based interventions to support BF, which requires an understanding of the factors that affect infant feeding patterns. The current study was based on a conceptual framework that classifies determinants of infant feeding patterns into structural, cultural, psychological and physical, and institutional domains, consistent with contemporary maternal and child health theories. This is the first national study in the Al-Aflaj region of Saudi Arabia, where a cross-sectional study was conducted at Al-Aflaj General Hospital and healthcare centers. 653 infants, aged 6 to 24 months, were included in the final analysis. 653 infants, aged 6 to 24 months, were included in the final analysis. Results of discriminant analysis were presented as standardized coefficients to identify the factors significantly associated with infant feeding. Although patterns. It was categorized as three outcomes (3) practicing exclusive breastfeeding (EBF), (2) mixed BF, and (1) formula feeding. Results of the current study revealed that the rate of mixed feeding was 37.5%, followed by EBF at 35.5% and formula feeding at 27%. The discriminant analysis (DA) demonstrated a good fit and strong classification accuracy (91.4%). Strong positive predictors are colostrum feeding (0.985), accurate knowledge of the definition of EBF (0.670), antenatal care visits (0.620), rooming-in (24 hours) (0.568), BF initiation within three days (0.549), antenatal BF education (0.530), mode of delivery (0.524), Knowledge of EBF benefits (0.518), husband's support and family (0.465. Conversely, the variables least likely to practice EBF include work and study pressures (-1.024), insufficient milk supply (-0.663), traditions and beliefs related to BF, (-0.537), and prelacteal feeding (-.340). Institutional determinants also demonstrated a positive effect on exclusive breastfeeding, and structural, cultural, and psychological determinants indicated a dual role of facilitating or hindering EBF. Considering the results of this study, a systematic program to advance EBF is recommended. Enhance prenatal and postnatal education by highlighting the advantages of colostrum, the need of starting breastfeeding early, and knowledge of BFHI. Create policies at work that allow working mothers to breastfeed, such as flexible scheduling, lactation breaks, and support for a six-month maternity leave requirement. Addressing misconceptions and cultural barriers through community assistance and counseling.

Keywords: exclusive breastfeeding; discriminant analysis; infant feeding patterns; Al-Aflaj region.

I. INTRODUCTION

Breastfeeding (BF) is the first step toward the health of infants, mothers and communities. Exclusive breastfeeding (EBF) is defined by the World Health Organization (WHO) as "giving breast milk to infants from 0 to 6 months (24 weeks) of age, without feeding any food or liquid, even water, except syrups

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containing of vitamins, mineral supplements or medicine [1]. Previous studies indicate that it reduces the risk of respiratory illnesses, supports growth and immunity, lowers the chance of obesity, and enhances cognitive development in infants [2]. For mothers, BF offers several advantages, including a decreased risk of breast and ovarian cancer, a lower likelihood of developing type 2 diabetes, and reduced postpartum weight [3]. Globally, over the past twenty years, the rate of EBF has declined despite its proven and well-known benefits. The WHO and the United Nations Children's Fund (UNICEF) have set nutritional targets, including reaching at least 50% EBF by 2025, to address this issue; they have called for rapid action against child malnutrition [1].

The prevalence of EBF in Saudi Arabia is much lower than that reported by WHO and varies by region [4-6]. The BF range varies in the literature from 2.6% to 37%. The previous studies shows that Saudi has high rates of EBF initiation at delivery, followed by a declining trend [7, 8]. In line with global efforts to promote BF, and according to a recent national survey, only the rate of EBF did not exceed 15.5% [9]. Through the Baby-Friendly Hospital Initiative (BFHI), the Saudi government has encouraged BF [10], but regional differences and enduring obstacles still have an impact on the uptake of EBF. The purpose of this study is to investigate the impact of structural, cultural, psychological, and institutional determinants on infant feeding patterns, which captures the complex adaptive system that dictates BF behavior. Moreover, this study addresses a theoretical gap by integrating structural, cultural, psychological, and institutional determinants within a unified analytical framework. Furthermore, it fills an empirical gap by providing population-based evidence from Al-Aflaj Governorate. The overall aim was to provide national estimates of BF indicators developed by WHO and UNICEF [11], and identifies modifiable factors and interventions that can positively or negatively influence mothers' decisions to continue BF. Data were collected through a structured questionnaire, conceptually categorized into structural, cultural, psychological, and institutional determinants to ensure interpretative clarity. The research questions guiding this study are:

- How appropriate is discriminant analysis for differentiating between infant feeding patterns?
- What are the key structural, cultural, psychological, and institutional determinants influencing infant feeding patterns in Al-Afla?
- What are the main factors that difference between formula or mixed feeding and EBF?
- How might these results guide initiatives to support EBF in Al-Aflaj and other Saudi Arabian regions?

For decision-makers in the Al-Aflaj region, all nations with comparable features, and all researchers interested in BF, this study is important since it offers useful evidence regarding the status of BF. Promoting, defending, and supporting BF practice will be made easier with an understanding of the variables that affect baby feeding patterns.

II. LITERATURE REVIEW

The literature on infant feeding has been categorized into four main categories: structural, cultural, institutional, and psychological factors, to improve conceptual clarity. This categorization is consistent with contemporary theories in maternal and child health research. Structural factors include sociodemographic, economic, and biological characteristics, such as maternal education, employment status, income level, birth-related factors, and obstetric characteristics, which influence a mother's ability to continue BF. Previous studies conducted in Saudi Arabia have confirmed these correlations. There are many studies that reflect structural factors.

A cross-sectional study was conducted in four health care centers at Alehsa region in Saudi Arabi by Aldalili and El-Mahalli [12] aimed to measure the association between EBF and the sociodemographic and obstetric characteristics of mothers. EBF rate was 60%. Cessation of EBF was associated with sore breasts, younger age, milk quantity, and baby-centered factors. In a similar, study was carried out among 450 mothers of infants aged 6-24 months in Hail city [13]. The majority of mothers were aware of EBF, and 24% reported initiation of BF in one hour after delivery. Mothers who reported BF practice were 50.7%. They reported that BF practices are influenced by many sociodemographic characteristics. Aljawoan et al. [14],

who focused on working moms in Riyadh, found that only 28% of mothers exclusively breastfed for the first six months of the child's life, underscoring the difficulties employed women experience in maintaining EBF.

A cross-sectional analysis study was conducted in Damietta, Egypt. Only 15.2% of mothers breastfed their infant exclusively for 6 months. A statistically significant association between good knowledge and EBF practice with highly educated mothers aged 26-30 years [15]. A study searched at PubMed, CINAHL, and Scopus databases for studies published in Tanzania between 2014 to 2024. A total of 130 studies were identified and their abstracts were reviewed. The analysis showed that working mothers were less likely to EBF, and identified maternal education, socioeconomic status, healthcare, and social support as key determinants [16].

The values, traditions, and beliefs that are common are referred to as cultural determinants. Understanding the cultural determinants is crucial for promoting EBF. According to previous literature infant feeding patterns are influenced by cultural and societal factors. In Saudi Arabia, only 5.3% of women in Jeddah used EBF, according to Albar's [17] assessment of newborn feeding patterns, with the majority using mixed or formula feeding, suggesting that infant feeding may be influenced by prevailing beliefs, traditions, and maternal perceptions. Elgzar et al. [18] found that 40.9% of Saudi nursing mothers in the Najran region exclusively breastfed their infants, and they emphasized the importance of cultural determinants, including beliefs and social attitudes, in lowering EBF practices among Saudi mothers.

Outside the Saudi context, previous studies show that EBF clinics in Palestine, via interviews with 495 mothers, who had babies aged 6-12 months. Of the participating mothers, 38.2% reported EBF [19]. The most common obstacle was the insufficient breast milk perception, reflecting culturally mediated maternal beliefs and social narratives surrounding milk adequacy. A survey of 685 mothers in Southern China was conducted [20]. It was found that 53.0% of mothers exclusively breastfed their babies for five months, while 47.0% of them continued EBF. The analysis identified 4 independent factors associated with the continuation of EBF: parity, BF counseling during pregnancy, return to work. Family support attitudes played a decisive role in continuation of EBF. In Australia, a thorough survey looked at when children started BF, the duration of EBF, and when they initiated eating supplementary foods. A study discovered that the duration of EBF up to six months was declining, even though most infants started BF early [21]. During the 2022 infant formula supply crisis, the United States saw changes in newborn feeding, including higher rates of BF initiation [22], demonstrating the importance of social and cultural variables in infant feeding decisions.

Institutional practices, such as health center support, prenatal care visits, antenatal and postpartum education, awareness of BFHI, time of BF initiation, and skin-to-skin contact, could overcome BF problems. Institutional support is also an important factor influencing the continuation of BF, which underscores the importance of institutional factors. Evidence from Saudi Arabia highlights this role. The study by Hassounah et al. [23], was designed as cross-sectional of mothers of children aged 6-24 months in Riyadh. There seemed to be a drop in EBF with time: from 35.3% in the first 2 months to 20.7% in the final two months, suggesting gaps in institutional support within healthcare services. Altamimi et al. set out to investigate the incidence of EBF and the variables affecting its onset [24] and conducted a cross-sectional study among 449 Saudi mothers who were enrolled in primary healthcare clinics in Riyadh. The BF prevalence rate was 86.6% among mothers, but EBF was not included. A cross-sectional study was performed by Alsada et al. [25], via interviews with 395 mothers living in Eastern Province, who had babies aged 6-24 months. They found that early initiation of BF limited, and that the EBF rate at 6 months was 25%, indicating the need for strengthened institutional support. A large multicenter observational study that looked at the incidence of EBF, mixed feeding, and formula feeding at hospital release and one month postpartum in Spain emphasized high rates of EBF following hospital discharge [26]. These findings healthcare support, institutional counseling, and hospital practices within the institutional factors of the conceptual framework guiding our study.

Psychological and physical factors also play a key role in infant feeding patterns. The authors noted that the psychological and physical factors affecting BF have been the subject of intense debate in recent years. Knowledge of EBF benefits and EBF definition, previous BF experience, colostrum feeding, and number of BF times influence EBF practices. These factors can greatly influence BF. In contrast to institutional factors, these factors reflect internal processes that influence the outcomes of BF behaviors. Yousefi et al. [27]

identified BF self-efficacy among pregnant mothers. including intentions to breastfeed. The study was conducted at University Hospital of King Saud University. They found a strong positive correlation between previous BF experiences and EBF.

1. CRITICAL ANALYSIS FOR LITERATURE REVIEW

Despite these contributions, there are still large gaps. Previous studies have not specifically addressed newborn feeding practices in the Al-Aflaj region, although the region's distinctive structural characteristics, such as demographic, socioeconomic, and other factors, may influence mothers' decisions regarding infant feeding. Psychological factors and institutional channels may play a role in predicting these decisions. While most previous research has focused on logistic analysis and descriptive statistics, our work use discriminant analysis (DA). DA is a potential tool that can be used to quantitatively evaluate the activeness of health programs and feeding. This study highlights how varying discriminant analysis models can be used to discriminate infant feeding patterns (EBF, mixed, and formula), with high specificity among Al-Aflaj communities in Saudi Arabi, in line with earlier research using DA in the nutrition and health sciences. For example, in previous studies, this analysis has been used to differentiate between feeding groups, such as formula-fed versus breastfed infants, showing distinct classification among feeding categories. This further supports the possibility of applying discriminant analysis techniques to study complex health outcomes, and this confirms the suitability of discriminant analysis methodologies for our study. [28, 29].

Also, the reviewed literature demonstrates that infant feeding patterns are shaped by an interplay of structural, cultural, institutional, and psychological factors. Although previous studies have identified various influencing factors, limited studies have integrated these factors within a conceptual framework in the Saudi context. Therefore, the current study aims to address this gap by examining these factors and determinants, thus providing a more comprehensive understanding of infant feeding patterns in Al-Aflaj Governorate.

2. THEORETICAL BACKGROUND

Practices of infant feeding are defined by a complex of interplaying personal, social, and structural factors. To study these forces in greater depth, the current paper is based on three interconnected theories, including health behavior theory, sociocultural theory, and institutional support theory. Using a combination of these methods, the research becomes a holistic framework, which helps in comprehending the factors that establish the patterns of infant feeding in the Saudi situation.

From a health behavior theory: Education strategies to benefit mothers are guided by a theory of health behavior, and studies indicates that utilization of behavioral models and theories for nutrition education interventions improves effectiveness [30]. Within the often-applied Planned Behavior Theory, and Health Belief Model, infant feeding constructs, include parental feeding attitudes, perceptions, environmental, constraints beliefs, social norms, as well as skills and knowledge. Mothers who are aware of the benefits of EBF, who have previous positive BF experiences, and who feel confident in their ability to breastfeed are more likely to initiate and continue EBF. The psychological preparedness, perception of having enough milk, and previous intention of BF are major factors that may determine the outcome of feeding by the mother. In this perspective, personal cognitive convictions and motivational factors are the key factors in infant feeding behavior.

The theory first proposed by Lev Vygotsky [31] is a sociocultural theory which underlines the fact that cognitive development is immensely shaped by the cultural context and continuous social interactions. When applied to infant feeding, the view attracts attention to the existing cultural norms and common practices regarding infant nutrition, as well as provides a systematic guideline on the formulation of specific measures to enhance infant feeding programs. In many communities, infant feeding practices are influenced by the values, beliefs, customs, and tools specific to a community, cultural perceptions, and social attitudes toward BF in public or at work. The cultural beliefs and family structures within the Saudi context can greatly influence a mother into making a decision on whether she should exclusively, mix feed or feed her baby on formula. Such a view highlights the fact that the issue of infant feeding does not solely depend on personal preferences but also on the larger social and cultural standards.

The view of the institutional support theory is concerned with how healthcare mechanisms, workplace conditions, and policy environments can benefit the behavior of mothers [32]. Provision of antenatal education, postpartum counseling, Baby-Friendly Hospital Initiative (BFHI), and workplace support of BF mothers might have a significant impact on continuation of feeding. Even the highly motivated mothers can experience some difficulties in the practice of EBF when the institutional support is of limited strength. Thus, the institutional structures may support or limit the recommended feeding practices.

The current research has a multidimensional approach to infant feeding patterns by incorporating these three perspectives. health behavior theory, sociocultural theory and institutional support theory. Structural characteristics such as education, income, and employment status are considered alongside cultural influences, psychological determinants. This integrated framework provides a clearer conceptual basis for understanding variations in exclusive, mixed, and formula feeding practices in Al-Aflaj Governorate.

III. METHODOLOGY

1. STUDY SETTING

A cross-sectional study was conducted at Al-Aflaj General Hospital and its affiliated primary healthcare centers during the period from September to December 2025.

2. PARTICIPANTS AND SAMPLING STRATEGY

A systematic random sampling technique was employed. Records from Al-Aflaj General Hospital and its affiliated primary healthcare centers indicated that approximately 2,400 eligible mothers attended these facilities during the study period. The required sample size was determined to be 653 individuals, with a 95% confidence interval, a 5% error rate, and a 40% projected prevalence. As a result, a sampling interval of three was used, and until the desired sample size was reached, every third eligible mother was asked to take part. Mothers of children between aged 6 – 24 months who visited the hospital or related primary healthcare facilities within the study period were included in the study. Infants with medical issues that potentially influence nursing behaviors and mothers with medical illnesses that preclude BF were not included.

3. DATA COLLECTION

A thorough literature review served as the foundation for the questionnaire's development. The original English-language version of the questionnaire was then translated into Arabic because it was intended to be given to the study population in Arabic. Mothers in the Al Aflaj region who attend Al-Aflaj General Hospital and its related health care facility and have children between aged 6 – 24 months, participated in structured interviews for this cross-sectional study.

The questionnaire had 30 items that were categorized into four domains namely Structural determinants (11 items), cultural determinants (3 items), psychological and physical determinants (8 items), and institutional determinants (8 items). Everything was organized and is presented in Tables 3 and 4. The answers were given in a coded form in order to perform statistical analysis. (for example, EBF = 3, mixed feeding = 2, formula feeding = 1). In the case of dichotomous variables, the answers were coded as 1 = No, and 2 = Yes. Likewise, the ordinal variables with three levels were coded with the lowest value and then moved to the highest value.

4. RELIABILITY AND VALIDITY OF THE QUESTIONNAIRE

The questionnaire's content validity was confirmed by scholars with expertise in mother and child health, who also examined the items to make sure they were appropriate for Saudi Arabian culture. Their input was used to modify the questionnaire. To guarantee the scale's high reliability and validity, 50 moms participated in a pilot study of the questionnaire's questions. Because Guttman's Lambda coefficients offer more flexibility in assessing dependability, they were utilized to examine the validity and reliability of the scale [33]. With coefficients of Guttman's Lambda ranging from 0.701 to 0.777, the content validity for every domain is greater than 70%. These findings indicate good internal consistency among the 30 questionnaire items and support the suitability of the instrument for the current study (Table 1).

Table 1. Reliability statistics for scale (Guttman's Lambda coefficients).

N. of items	Guttman's Lambda coefficients				
	Lambda 2	Lambda 3	Lambda 4	Lambda 5	Lambda 6
30	.701	.737	.768	.768	.777

5. VARIABLES OF THE STUDY

The study considered infant feeding status at six months as the dependent variable, categorized into three distinct groups based on feeding patterns: EBF, mixed feeding, and formula feeding. EBF represents the optimal nutrition for infants [1]. Mixed feeding refers to infants who receive breast milk in combination with formula milk and/or complementary foods during the same period. Formula feeding refers to infants who are fed exclusively with commercially prepared infant formula. These classifications are consistent with internationally recognized standards for infant feeding practices, and definitions were based on WHO indicators for infant feeding [11].

The study also identified independent variables that have been shown to be associated with determinants of EBF. These included structural determinants refer to sociodemographic characteristics, cultural determinants refer to social norms, and family influences that shape maternal feeding decisions, psychological and physical determinants refer to maternal perceptions, knowledge, attitudes, and previous experiences, and institutional determinants refer to capture the support, guidance, and practices provided by healthcare facilities and structured programs.

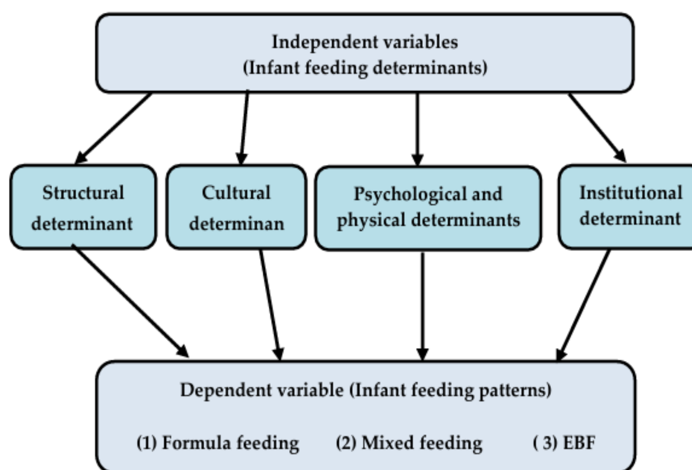

FIGURE 1. Conceptual framework illustrating the hypothesized influence of structural, cultural, psychological and physical, and institutional determinants on infant feeding patterns.

6. STATISTICAL ANALYSIS

Prior to analysis, the data were cleaned and systematically reviewed, and outliers were appropriately addressed. Statistical analyses were conducted using SPSS software (version 28). To provide a summary of the demographic traits of mothers and their offspring, frequency and percentage tables were created. It made use of discriminant analysis (DA). There were several independent variables and one dependent variable. Three outcomes were associated with the dependent variable: (1) formula feeding exclusively, (2) mixed EBF, and (3) EBF practice. Factors substantially linked to EBF practices were identified. Both standardized and unstandardized discriminant function coefficients were calculated to assess the relative contribution and direction of each independent variable in discriminating between the infant feeding groups. Statistical significance was set at a p-value of less than 0.05. To evaluate the predictive stability and generalizability of

the discriminant model, the internal validation method was used; the leave-one-out cross-validation (LOOCV) procedure was adopted to eliminate the possibility of overestimating the accuracy of the classification and decrease the overfitting of the model.

7. BIAS ASSESSMENT

There are a number of possible bias sources which were taken into consideration during the formation and conduction of this study. To begin with, the first is recall bias; since mothers were requested to report infant feeding practices in the past, recall bias might occur. To solve this, the infants in the study were between the ages of 6-24 months because WHO rules and requirements on EBF require as much as six months to ascertain the feeding status. In addition to this, the majority of the infants in the sample (79.3) were below 12 months, shortening the duration of the recall period.

Additionally, to reduce the risk of the recall bias, the chosen information was compared with the hospital and primary healthcare center records as much as possible. Furthermore, structured interviews were used to collect data using a trained research team to provide consistency in the questioning process and eliminate interviewer-based variability. Systematic random sampling was used to reduce selection bias; every third eligible mother was invited to participate until the target sample size was achieved. Although these measures have been put in place, just like any cross-sectional study that uses self-report data partially, some residual recall bias will be unable to be entirely eliminated.

8. CAUSAL AND ANALYTICAL LIMITATIONS

Due to the cross-sectional design of the study, causal relationships cannot be established, and the conclusions can be viewed as associations, but not causal. Whereas the discriminant analysis establishes variables that make significant distinctions between infant feeding groups, the method fails to establish temporal sequencing and cause-effect. Also, the model is based on the statistical assumptions of multivariate normality and the lack of perfect multicollinearity, which can create limitations to the analysis. Thus, the findings are to be explained in the methodological frames of observational studies. The linear correlation diagnostics (Table 5) were calculated using tolerance and Variance Inflation Factor (VIF) values, which showed the acceptable values and justified the stability of the model.

IV. DATA ANALYSIS

1. CHARACTERISTICS OF STUDY PARTICIPANTS

Table 2 presents the distribution of infant feeding patterns at six months according to maternal age. A total of 653 mothers were included in the analysis. The largest proportion of mothers (46.4%) were aged 21–34 years, followed by 33.1% under 20 years and 21.5% over 35 years. Formula feeding only was most prevalent among mothers younger than 20 years (37.5%), whereas EBF was more common among mothers over 35 years (46.3%). Mixed feeding was most frequently reported among mothers aged 21–34 years (40.9%). Overall, mixed feeding was the most common infant feeding practice (37.5%), followed by EBF (35.5%) and formula feeding only (27.0%).

Table 2. Distribution of study participants by infant feeding pattern and maternal age (N = 653).

	Mother's age (years)			
Type of Infant Feeding	< 20 years,	21–34 years,	> 35 years,	Total,
Formula Only	81 (37.5)	70 (23.1)	25 (18.7)	176 (27.0)
Mixed	74 (34.3)	124 (40.9)	47 (35.1)	245 (37.5)
Exclusive Breastfeeding (EBF)	61 (28.2)	109 (36.0)	62 (46.3)	232 (35.5)
Total	216 (33.1)	303 (46.4)	134 (21.5)	653 (100.0)

Table 3 presents the distribution of study participants according to structural and cultural determinants that may influence infant feeding patterns among 653 mothers, providing a basis for understanding the relationships that will be analyzed in subsequent findings. More than half of the mothers (56.5%) and fathers (52.7%) had a university education or higher. More than half of the mothers were employed or students (59.6%), whereas 40.4% were housewives. The majority of families reported a monthly income between 5,000 and 10,000 Saudi Riyals (65.5%). The majority of families reported a monthly income between 5,000 and 10,000 Saudi Riyals (65.5 %). Most deliveries were full-term (81.6%), and 70.3% of mothers reported an interpregnancy interval of 24 months or longer which may affect continuation of BF . The majority of mothers delivered via spontaneous vaginal delivery (77.3%), whereas 22.7% underwent cesarean section, influence BF initiation and continuation. Regarding child characteristics, most infants were aged 6–12 months (79.3%), the majority were second-born children (61.7%), and most had a normal birth weight between 2.5 and 3.5 kg (62.5%), while 24.8% weighed more than 3.5 kg. Concerning cultural factors, social and cultural barriers to EBF were reported by 61.6% of participants, while husband support was reported by 28.2%, and prelacteal feeding was common (61.7%), which can interfere with EBF.

Table 3. Distribution of study participants by structural and cultural determinants (N = 653).

Domain	Independent Variable	Category	N	%
Structural determinants	Mother's education level	Secondary	284	(43.5)
		University and more	369	(56.5)
	Father's education level	Secondary	309	(47.3)
		University and more	344	(52.7)
	Mother's employment status	Employee/student	389	(59.6)
		Housewife	264	(40.4)
	Family monthly income (SR)	< 5000	105	(16.1)
		5000–10000	428	(65.5)
		> 10000	120	(18.4)
	Gestational age at delivery	Preterm	120	(18.4)
		Full-term	533	(81.6)
	Mode of delivery	CS	148	(22.7)
		SVD	505	(77.3)
	Interpregnancy interval	< 24 months	194	(29.7)
		≥ 24 months	459	(70.3)
	Birth order	First	91	(13.9)
		Second	403	(61.7)
		Third and more	159	(24.3)
	Child's age (months)	6–12	518	(79.3)
		13–23	135	(20.7)
	Birth weight (kg)	< 2.5	83	(12.7)
		2.5–3.5	408	(62.5)
		> 3.5	162	(24.8)
Cultural determinants	Social and cultural barriers to EBF	No	251	(38.4)
		Yes	402	(61.6)
	Husband and family support	No	469	(71.8)
		Yes	184	(28.2)
	Prelacteal feeding	No	250	(38.3)
		Yes	403	(61.7)

Table 4 presents the distribution of participants according to psychological and physical determinants, and institutional factors that may influence infant feeding practices. Perceived insufficient breast milk was

reported by 56.4% of mothers, highlighting a potential psychological barrier to maintaining EBF, while 63.6% reported experiencing health problems, and 47.6% of mothers reported having health problems related to the infant. Knowledge gaps were evident, as only 30.3% of mothers correctly identified the definition of EBF, although 66.3% were aware of its benefits, indicating room for educational interventions. Most mothers reported previous BF experience (82.7%). Colostrum feeding was reported by only 36.4%. Regarding BF frequency, 43.0% of mothers breastfed more than eight times per day, reflecting variations in feeding intensity.

Institutional determinants describe the support available to mothers. Health center support was reported by 37.5% of mothers. Most mothers attended antenatal visits, with 46.7% reporting more than three visits. Antenatal education about EBF was reported by 57.1%, whereas postpartum EBF education was received by only 37.4%. Awareness of the BFHI was reported by 36.8% of participants. Skin-to-skin contact after birth was reported by approximately half of the mothers (51.0%), while two-thirds practiced rooming-in for 24 hours (66.5%). BF initiation was often delayed, with 48.9% initiating after three days postpartum

Table 4. Distribution of study participants by psychological and physical, and institutional determinants (N = 653).

	Variable	Category	N	%
Psychological and physical determinants	Perceived insufficient breast milk	No	285	(43.6)
		Yes	368	(56.4)
	Maternal health issues	No	238	(36.4)
		Yes	415	(63.6)
	Infant health issues	No	342	(52.4)
		Yes	311	(47.6)
	knowledge of EBF definition	No	455	(69.7)
		Yes	198	(30.3)
	Knowledge of EBF benefits	No	220	(33.7)
		Yes	433	(66.3)
	Previous BF experience	No	113	(17.3)
		Yes	540	(82.7)
	Colostrum feeding	No	415	(63.6)
		Yes	238	(36.4)
	Number of BF times/24 h	Not BF	118	(18.1)
		< 8	254	(38.9)
		> 8	281	(43.0)
Institutional determinants	Health center support	No	408	(62.5)
		Yes	245	(37.5)
	Antenatal care visits	No visit	69	(10.6)
		1–3 visits	279	(42.7)
		>3 visits	305	(46.7)
	Antenatal EBF education	No	280	(42.9)
		Yes	373	(57.1)
	Postpartum EBF education	No	409	(62.6)
		Yes	244	(37.4)
	Awareness of BFHI	No	413	(63.2)
		Yes	240	(36.8)
	Skin-to-skin contact after birth	No	320	(49.0)
		Yes	333	(51.0)
	Time of BF initiation	Not BF	125	(19.1)
		Within first 3 days	209	(32.0)

	After three days	319 (48.9)
Rooming-in (24 hours)	No	219 (33.5)
	Yes	434 (66.5)

2. ASSESSMENT OF MULTICOLLINEARITY AND SIGNIFICANCE OF INDEPENDENT VARIABLES

Multicollinearity diagnostics among the independent variables, as presented in Table 5, indicated acceptable variance inflation factor (VIF) value and tolerance levels. Tolerance values ranged from 0.51 to 0.85, exceeding the minimum acceptable threshold (Tolerance > 0.20), while VIF values ranged from 1.17 to 1.97, which are well below the commonly accepted critical value (VIF < 5). These findings indicate that multicollinearity was not a concern and did not threaten the stability or validity of the DA model. Independent variables represented structural, cultural, Psychological and physical determinants, and institutional determinants entered simultaneously into the discriminant analysis model. The selection of independent variables for inclusion in the discriminant function was based on their discriminatory power, as indicated by Wilks' Lambda values, associated F statistics, and statistical significance levels ($p < 0.05$). As shown in Table 5, 26 independent factors demonstrated statistically significant discriminative ability and were therefore retained in the model.

In contrast, four variables, child's age in months ($p = .833$), father's education level ($p = .264$), maternal health-related discontinuation of EBF ($p = .245$), and infant health-related discontinuation of EBF ($p = .063$) did not reach statistical significance and were excluded from the analysis. Excluding these variables improved of the model by restricting it to predictors with meaningful discriminative relevance in distinguishing infant feeding patterns.

Table 5. Multicollinearity diagnostics, and significance tests of independent variables (Infant feeding determinants).

No.	Independent Variable	Tolerance	VIF	Wilks' Lambda	F	Sig.
q1	Mother's age (years)	.76	1.32	.969	10.37	.000
q2	Mother's education level	.74	1.35	.984	5.26	.005
q3	Father's education level	.76	1.31	.996	1.33	.264
q4	Mother's employment status	.70	1.42	.732	118.71	.000
q5	Family monthly income (SR)	.81	1.23	.860	53.10	.000
q6	Gestational age at delivery	.81	1.24	.946	18.57	.000
q7	Mode of delivery	.80	1.24	.869	48.80	.000
q8	Interpregnancy interval	.63	1.59	.882	43.40	.000
q9	Birth order	.84	1.20	.881	43.74	.000
q10	Child's age (months)	.83	1.21	.999	.18	.833
q11	Birth weight (kg)	.78	1.29	.982	5.94	.003
q12	Social and cultural barriers to EBF	.64	1.56	.698	140.56	.000
q13	Husband and family support	.67	1.49	.986	4.59	.011
q14	Prelacteal feeding	.64	1.57	.757	104.45	.000
q15	Perceived insufficient breast milk	.67	1.49	.710	132.45	.000
q16	Maternal health issues	.79	1.26	.996	1.41	.245
q17	Infant health issues	.62	1.61	.992	2.77	.063
q18	Knowledge of EBF definition	.61	1.64	.848	58.20	.000
q19	Knowledge of EBF benefits	.51	1.96	.980	6.50	.002
q20	Previous BF experience	.75	1.33	.855	55.10	.000
q21	Colostrum feeding	.64	1.56	.677	155.03	.000

q22	Number of BF times within 24 hours	.57	1.76	.665	163.99	.000
q23	Health center support	.75	1.33	.820	71.32	.000
q24	Antenatal care visits	.62	1.60	.693	143.86	.000
q25	Antenatal EBF education	.50	2.00	.890	40.30	.000
q26	Postpartum EBF education	.76	1.31	.883	43.25	.000
q27	Awareness of BFHI	.75	1.34	.829	66.89	0.00
q28	Skin-to-skin contact after birth	.63	1.58	.944	19.15	.000
q29	Time of BF initiation	.63	1.58	.620	199.47	.000
q30	Rooming-in (24 hours)	.52	1.93	.976	8.09	.000

3. *EQUALITY OF COVARIANCE MATRICES, GROUP CENTROIDS, AND CLASSIFICATION ACCURACY*

As presented in Table 6, the group centroids illustrate the relative positioning of infant feeding patterns along the discriminant function and demonstrate a clear separation among the three feeding groups. Formula feeding was at the negative end of the discriminant function (−3.31), whereas EBF displayed the highest positive centroid value (1.99). Mixed feeding held an intermediate position at the middle (0.49). This ordered distribution confirms the strong discriminatory capability of the discriminant function and shows a consistent gradient across eating patterns.

The equality assumption of covariance matrices across the feeding groups was examined using Box's M test. As shown in Table 6, the test was statistically significant (Box's M = 3201.00, F = 4.30, $p < 0.001$), indicating a violation of the homogeneity assumption. However, given the relatively comparable values of the log determinants across groups and the large sample size, the application of linear DA was considered appropriate. The rank column indicates that 26 independent variables were retained in constructing the discriminant function.

Table 6. Functions at group centroids, equality box's test of covariance matrices.

Type of Infant Feeding	Group Centroid	Rank[a]	Log Determinant	Box's M	F	Sig.
Formula	−3.31	26	−50.10			
Mixed	0.49	26	−45.91	3201.00	4.30	0.000
EBF	1.99	26	−47.33			

Classification results demonstrated high predictive accuracy Table 7. The initial classification score of the discriminant model was 90.4%. Following the use of leave-one-out cross-validation, the overall estimation accuracy was taken to be 89.4, which means that the model is stable and not subject to overfitting. The slight variance of the original and cross-validated accuracy proves the predictive quality and reliability of the model. The correct classification rates were 91.5% for formula feeding, 87.3% for mixed feeding, and 88.8% for EBF, indicating a good discriminative performance of the model across all feeding patterns.

Table 7. Original and cross-validated classification results [a,c] of the discriminant model.

Type of Infant Feeding	Original			Cross-validated			
	Formula	Mixed	EBF	Formula	Mixed	EBF	Total
Formula	166 (94.3)	10 (5.7)	0 (0.0)	161 (91.5)	15 (8.5)	0 (0.0)	176
Mixed	7 (2.9)	215 (87.8)	23 (9.4)	8 (3.3)	214 (87.3)	23 (9.4)	245
EBF	1 (0.4)	19 (8.2)	212 (91.4)	0 (0.0)	26 (11.2)	206 (88.8)	232

a. 91.4% of original grouped cases correctly classified.
b. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.
c. 89.4% of cross-validated grouped cases correctly classified.

4. SUMMARY OF CANONICAL DISCRIMINANT FUNCTIONS

As presented in Table 8, two canonical discriminant functions were extracted to distinguish among the three infant feeding patterns: EBF, mixed feeding, and formula feeding. The first discriminant function accounted for the majority of the between-group variance (81.0%), with a high eigenvalue (4.53) and a strong canonical correlation (0.91). This function was statistically significant (Wilks' Lambda = 0.09, $\chi^2 = 1552.32$, $p < 0.001$), indicating that it represents the primary dimension separating the feeding groups. The second discriminant function explained the remaining 19.0% of the variance and also showed statistically significant discriminatory ability, with an eigenvalue of 1.07, a canonical correlation of 0.72, and Wilks' Lambda = 0.48 ($\chi^2 = 462.13$, $p < 0.001$).

Table 8. Summary of canonical discriminant functions.

Function	Eigenvalue	Variance %	Canonical correlation	Wilks' Lambda	χ^2 Chi-Square	Sig.
Function 1	4.53	81.00	0.91	0.09	1552.32	0.00
Function 2	1.07	19.00	0.72	0.48	462.13	0.00

5. RELATIVE CONTRIBUTION OF FACTORS AFFECTING INFANT FEEDING PRACTICES

As indicated in Table 9, the canonical discriminant function coefficients were obtained from the original data in the last stage of the discriminant analysis. One important result of the discriminant analysis is this table, as it quantifies the relative contribution of each independent variable to distinguishing among infant feeding patterns. Because the independent variables were measured using multiple scales and units, the results were interpreted mainly using the standardized canonical discriminant function coefficients. It offers a more suitable and comparable way to gauge the relative significance of variables affecting newborn feeding patterns. The results indicate that the behavior of BF exists in a multilevel system and structural, cultural, psychological and physical, and institutional determinants influence the outcome of infant feeding.

Structural determinants proved to have distinct discriminatory ability when it came to the differentiation of infant feeding patterns. Among the structural variables, mode of delivery (.524) showed the strongest positive discriminative contribution. This was followed by maternal age (.337). Subsequent positive contributors included birth order (.297), gestational age at delivery (.220), interpregnancy interval (.197), and finally birth weight (.085). In contrast, several structural determinants showed negative associations with EBF. The strongest negative contributor was maternal employment status (-1.024). This was followed by family monthly income (SR) > 10000 (-.286), while the least negative impact was the high level of maternal education (-.162). These findings suggest that certain socioeconomic characteristics may relate to less optimal BF patterns.

Cultural determinants demonstrated a substantial role in differentiating infant feeding patterns. Among cultural factors, husband and family support (.465) showed the strongest positive discriminative contribution. On the contrary, social and cultural barriers to EBF (-.537) had the most negative impact among the determinants of culture, indicating that restrictive norms, misconceptions, or social pressures have a significant negative impact on EBF. This was followed by prelacteal feeding (-.340). There were psychological and physical determinants that showed some of the strongest levels of discriminative contributions in the model. Colostrum feeding (.985) was the greatest positive discriminative coefficient in the whole model. This was coupled with knowledge EBF definition (.670) and the knowledge EBF benefits (.518). Other contributors that were positive were past experience with BF (.455) and competence as well as number of times breastfed in 24 hours (.339). Conversely, perceived inadequate breast milk (-.663) showed significant negative influence, as it is one of the strongest psychological impediments.

Institutional determinants also demonstrated a substantial role in differentiating infant feeding patterns. Antenatal care visits (.620) were found to be the most positive discriminant factor of institutional factors. This was then succeeded by rooming in a 24-hour period (.568) and initiation of BF time (.549). Additional positive factors were the antenatal EBF education (.530) and the awareness of BFHI (.447). There were also

positive associations with skin-to-skin contact after birth (.357), health center support (.349), as well as postpartum EBF education (.204), although with less discriminative power. All the institutional variables of this model had positive standardized coefficients. This suggests that institutional support consistently function as facilitators rather than barriers to EBF.

Table 9. Standardized and unstandardized canonical discriminant function coefficients for infant feeding patterns.

No.	Factors affecting types of infant feeding.	Standardized Coefficient	Unstandardized Coefficient
q1	Mother's age (years)	.337	.240
q2	Mother's education level	-.162	-.080-
q3	Mother's employment status	-1.024	-.431-
q4	Family monthly income (SR)	-.286	-.156-
q5	Gestational age at delivery	.220	.083
q6	Mode of delivery	.524	.205
q7	Interpregnancy interval	.197	.085
q8	Birth order	.297	.170
q9	Birth weight (kg)	.085	.051
q10	Social and cultural barriers to EBF	-.537	-.219
q11	Husband and family support	.465	.208
q12	Prelacteal feeding	-.340	-.144
q13	Perceived insufficient breast milk	-.663	-.278
q14	Knowledge of EBF definition	.670	.284
q15	Knowledge of EBF benefits	.518	.243
q16	Previous BF experience	.455	.159
q17	Colostrum feeding	.985	.391
q18	Number of BF times within 24 hours	.339	.205
q19	Health center support	.349	.153
q20	Antenatal care visits	.620	.344
q21	Antenatal EBF education	.530	.248
q22	Postpartum EBF education	.204	.093
q23	Awareness of BFHI	.447	.197
q24	Skin-to-skin contact after birth	.357	.174
q25	Time of BF initiation	.549	.305
q26	Rooming-in (24 hours)	.568	.265
	Constant	-	-8.22

V. DISCUSSION

The current study is the first national study in Al Aflaj Governorate in Saudi Arabia to investigate the factors affecting infant feeding types, using DA. It is the first quantitative analytical assessment of BF support and newborn feeding habits. DA provides sufficient power for a good statistical analysis of the various determinants influencing types of infant feeding. This study demonstrates a significant deviation from WHO recommendations. The findings confirm a decline in the rate of EBF practiced. The current study demonstrated that 37.5% of mothers adopted mixed feeding, while 35.5% used EBF, and 27.0% used formula feeding. This is corroborated by similar findings from a study conducted in Riyadh [14]. Similar studies conducted in various regions in Saudi Arabia have also reported proportions of BF rates ranging from 1.8% to 66.7% [5, 6, 9], these variations reflect contextual, societal, and geographical variations in BF behaviors. Longer duration of exclusive breastfeeding has been associated with improved child development outcomes and optimal growth patterns according to recent evidence [34-36]. Globally, EBF rates during the first six

months reaching 48% [37]. BF behavior could be considered through the systems theory as the product of interactions among several interdependent subsystems, such as individual, family, healthcare, workplace, and larger sociocultural systems. The current results depict how infant feeding practices are neither predetermined by single determinants, but daily by dynamic interrelations between the levels.

Consistent with the Social Determinants of Health framework, the maternal employment, income, education, and access to antenatal care are structural conditions that are upstream determinants and influence maternal capability to continue to practice EBF. In the meantime, intermediary determinants, including family support, cultural norms, perceived milk insufficiency and institutional practices, including rooming-in mediate the conversion of these structural forces into actual feeding behaviors. Key findings of the current study were as follows: 26 factors were significantly associated with EBF practice. The factors more likely to practice EBF, ranked by highest statistical significance, are as follows: colostrum feeding as a decisive factor to practice EBF. Several studies supported this finding [38–40]. Accurate knowledge of the EBF definition has significantly contributed to discriminating between infant feeding types. Mothers with accurate knowledge were more likely to follow optimal nutrition practices, although there are persistent gaps in practical knowledge that have been noted in previous studies [18, 23, 36]. Antenatal care visits were positively associated with EBF, which was reported similarly by previous studies in Saudi Arabia, which stated that there is a strong relationship between antenatal care visits and actual practice [43–46]. Then the rooming-in (24 hours) was the influencing factor, where it is a significant factor in EBF practice. Mothers who share a room with their babies have higher levels of EBF practice compared to those without the rooming-in, followed by BF initiation within the first three days. Previous studies have been shown a significant relationship between the rooming-in and early initiation of EB, with EBF practice. Our results are consistent with several studies conducted in the same context in Saudi Arabia [7, 12, 13, 24, 36, 41], and outside Saudi context [39, 40].

The mode of delivery also played a role in EBF practices. EBF was found to be less in mothers who had delivered their babies via caesarean sections. This result is reinforced by study was conducted by number of researchers in Saudi Arabia [7, 12, 13, 24, 25]. Also, this is also confirmed by studies conducted outside the Saudi context [42, 43]. Then comes the support of the healthcare center and the husband, although their impact was moderate in distinguishing between types of infant feeding. Mothers who received expert help from healthcare providers and support from their husbands were more committed to recommended BF practices. These results are in line with past Saudi and foreign research emphasizing the value of support from the family and healthcare system in fostering BF [45, 46]. The same findings also confirm a systems-based explanation, in which the relationship and institutional subsystems relate to each other to either support or undermine BF sustainability.

On the other hand, the strongest factor increasing the likelihood of formula feeding and mixed feeding was the mother's work status. Working mothers were more likely to use mixed and formula feeding. Given that over half of the study sample consisted of working mothers and students, this finding is very pertinent. A reduced BF duration may be due to work responsibilities, returning to work early, rigid work schedules, and a lack of support in the workplace. Similar findings have been regularly reported internationally and in Saudi Arabia [12, 14, 47-49]. In structural determinants framework, the maternal employment was the strongest factor limiting opportunities for BF, unless support systems are available in the workplace.

Consistent with earlier local and international investigations, perceived inadequate breast milk was another significant negative predictor and was linked to decreased adherence to recommended EBF [39, 46, 49, 50]. Furthermore, there was a significant inverse relationship between social and cultural barriers and proper feeding behaviors. Social and cultural barriers to EBF, that promote prelacteal feeding, early supplementation, and family pressure particularly from older relatives continue to have an impact on maternal feeding decisions. These factors, which emphasize how beliefs affect how babies are fed [51, 52], have been widely documented in Saudi Arabia, as well as in other countries [39, 46, 50]. These cultural norms can be viewed as linked components of the family and the community system under a systems theory, which reinforces social feedback mechanisms to influence maternal transgression decision-making.

Our study has several strengths include a large sample size, would be more representative of the population and findings are generalizable in Saudi Arabia regions. Data were collected surveys and the person interviews for data collection, which provide more robust responses and enhancing reliability and generalizability compared to self-reported data. The questionnaire had clear questions and all relevant variables. Furthermore, interview-based data collection probably improved mothers' memory of information and decreased the possibility of information bias. Standardized interviewing methods and trained female data collectors were used to guarantee consistency and improve data reliability, and maternal recollections of childbirth and feeding were cross-checked with relevant hospital records whenever feasible to minimize recall bias.

DA allowed for a comprehensive evaluation of the separation between three baby feeding regimens (EBF, mixed feeding, and formula feeding) and 26 independent factors. The high apparent overall correct classification rate (91.4%) suggests good discriminative ability of the model, and supports the reliability of the findings. However, our research has many limitations. A significant drawback was the lack time frame used for data collection. A longitudinal study is therefore recommended to follow up with mothers and babies to assess the complete benefits of EBF. The cross-sectional design precludes causal inference, allowing only associations to be described. According to WHO guidelines, women with infants between the ages of 6 and 24 months had to be included in the evaluation of completed EBF. Mothers of children older than two years were excluded to reduce recollection bias, while mothers of younger infants were omitted to prevent misclassification of incomplete EBF.

VI. CONCLUSION

1. EMPIRICAL CONCLUSION

The current study provides significant novel data concerning the factors influencing the types of babies feeding in the Al-Aflaj region in Saudi Arabia. Although two-thirds of mothers knew about the advantages of BF, still, its prevalence is not as good as it should be. Formula and combination feeding remain commonly used.

The discriminant analysis ranked the variables according to their ability to distinguish between infant feeding patterns, such as colostrum feeding, accurate knowledge of the EBF definition, and antenatal care visits among the most influential factors. Then rooming-in (24 hours), time of BF initiation, antenatal EBF education, mode of delivery, Knowledge of EBF benefits ; husband and family support; previous BF experience; awareness of BFHI; skin-to-skin contact after birth; health center support; number of BF times within 24 hours; mother's age; birth order; gestational age at delivery; postpartum EBF education; interpregnancy interval; and birth weight were found to be positively linked with optimal baby feeding practices. On the other hand, mother's employment, perceived inadequacy of breast milk, social and cultural barriers to EBF, prelacteal feeding, family monthly income > 10000, and high level of maternal education were significant negative factors influencing baby feeding patterns. These findings demonstrate that infant feeding patterns are shaped by multiple interrelated structural, cultural, psychological and physical, and institutional determinants.

2. RECOMMENDATIONS

The final results of the study point to the need to elaborate on empirically validated and culturally sensitive interventions to facilitate and sustain EBF. To enhance EBF practices, maternal education programs should include improved prenatal and postoperative care with emphasis on the benefits of EBF, colostrum feeding, early BF initiation, and increased awareness of the Baby-Friendly Hospital Initiative (BFHI). Interventions should also be encouraged to involve grandparents, spouses, and other important family members in active participation in the process of family involvement. In order to support working women, BF -friendly workplace regulations must be put into place. Flexible work schedules, on-site lactation facilities, and up to six months of paid maternity leave are all examples of such programs. Healthcare providers should

also address maternal misconceptions regarding breast milk adequacy through to address these misconceptions, healthcare providers need possess current knowledge and effective counseling techniques.

Finally, a comprehensive understanding of the determinants of EBF is needed to increase optimal BF rates. Future research should design effective intervention strategies and continuously monitor the trend of EBF rate, potentially leading to more effective, and improvements in maternal and child health outcomes.

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Conflicts of Interest

The authors report no known competing interests associated with this publication.

Data Availability Statement

Data are available from the corresponding author upon reasonable request

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Ethics Approval

Ethical approval for this study was obtained from the Standing Committee of Bioethics Research at Prince Sattam bin Abdulaziz University (Protocol No: SCBR-603/2025).

REFERENCES

1. World Health Organization. (**2017**). *Global nutrition targets 2025: Policy brief on breastfeeding*. Switzerland.
2. Froń, A., & Orczyk-Pawiłowicz, M. (**2024**). Breastfeeding beyond six months: Evidence of child health benefits. *Nutrients, 16*(22), 3891.
3. Chęcińska-Maciejewska, Z., Ciborek, A., Krauss, H., & Gibas-Dorna, M. (**2024**). Advantages of breastfeeding for the mother–infant dyad. *Journal of Health Inequalities, 10*(1), 64–71.
4. Al-Thubaity, D. D., Alshahrani, M. A., Elgzar, W. T., & Ibrahim, H. A. (**2023**). Determinants of high breastfeeding self-efficacy among nursing mothers in Najran, Saudi Arabia. *Nutrients, 15*(8), 1919.
5. Alahmed, S., Meedya, S., Mutair, A. A., & Fernandez, R. (**2023**). Saudi women's breastfeeding knowledge, attitude, and practices: A systematic review and meta-analysis. *Journal of Transcultural Nursing, 34*(1), 68–82.
6. Azzeh, F. (**2017**). Determinants of exclusive breastfeeding and complementary feeding practices in Mecca City, Saudi Arabia. *International Journal of Child Health and Nutrition, 6*(2), 80–89.
7. Ahmed, A. E., & Salih, O. A. (**2019**). Determinants of early initiation of breastfeeding in Saudi Arabia. *International Breastfeeding Journal, 14*, 13.
8. Orabi, A. (**2025**). Breastfeeding practices and challenges in women with breast implants in Saudi Arabia. *Frontiers in Global Women's Health, 6*, 1647351.
9. Alhreashy, F. A., Alhammadi, A. I., Aljabar, B. A., et al. (**2025**). Prevalence and predictors of breastfeeding practices in Saudi Arabia. *International Breastfeeding Journal, 20*(1), 47.
10. Alghamdi, K. (**2022**). Saudi hospitals compliance with the Baby-Friendly Hospital Initiative. *Cureus, 14*(8), e27914.
11. World Health Organization & UNICEF. (**2021**). *Indicators for assessing infant and young child feeding practices*. Geneva: WHO.
12. Aldalili, A. Y. A., & El Mahalli, A. A. (**2021**). Factors associated with cessation of exclusive breastfeeding. *Journal of Multidisciplinary Healthcare, 14*, 239–246.
13. Alshammari, M. B., & Haridi, H. K. (**2021**). Prevalence and determinants of exclusive breastfeeding. *Scientifica*, 2021, 2761213.
14. Aljawoan, F. Y., Alabdulkarim, A. I., Alhumaidan, A. A., Alsaeed, R., & Aldosari, L. M. (**2024**). Exclusive breastfeeding among working mothers in Riyadh. *Cureus, 16*(4), e58729.

15. El-Gamel, N., & El-Nemer, A. (**2023**). Knowledge and practices of exclusive breastfeeding during COVID-19. *BMC Women's Health, 23*(1), 673.
16. Noorani, M., Osman, R., Abeid, M., Das, J., & Bhutta, Z. (**2025**). Determinants of exclusive breastfeeding in Tanzania. *International Breastfeeding Journal, 20*(1), 95.
17. Albar, S. A. (**2022**). Mothers' feeding practices among infants. *Journal of Nutritional Science, 11*, e83.
18. Elgzar, W. T., Al-Thubaity, D. D., Alshahrani, M. A., Essa, R. M., & Ibrahim, H. A. (**2023**). Maternal ideation and breastfeeding practice. *Nutrients, 15*(7), 1719.
19. Al-Aqqad, S., Abu-Alrob, L., Zakarneh, L., & Eqelan, A. (**2025**). Exclusive breastfeeding among Palestinian mothers. *Journal of Health, Population and Nutrition, 44*(1), 405.
20. Dai, T., Wan, J., Liu, Q., Liu, X., & Chen, C. (**2025**). Breastfeeding among healthcare workers in China. *International Breastfeeding Journal, 20*(1), 56.
21. Netting, M. J., Moumin, N. A., Knight, E. J., Golley, R. K., Makrides, M., & Green, T. J. (**2022**). Breastfeeding practices in Australia. *Nutrients, 14*(1), 206.
22. Cernioglo, K., & Smilowitz, J. T. (**2023**). Infant feeding during formula shortage crisis. *BMC Pediatrics, 23*(1), 320.
23. Hassounah, M., Dabbagh, R., & Younis, A. (**2023**). Postpartum counseling and breastfeeding. *Children, 10*(7), 1141.
24. Altamimi, A. F., Ababtain, R., Alahmari, M. S., & Altulaihi, B. A. (**2025**). Factors affecting breastfeeding initiation. *Journal of Health, Population and Nutrition, 44*(1), 83.
25. Alsada, F., Sebastian, T., Alzayer, Z., et al. (**2025**). Infant feeding practices in Saudi Arabia. *BMC Public Health, 25*(1), 388.
26. Reyes-Lacalle, A., Cabedo-Ferreiro, R. M., Cos-Busquets, J., et al. (**2025**). Breastfeeding barriers in Barcelona. *Nutrients, 17*(19), 3109.
27. Alyousefi, N., Alemam, A., Altwaijri, D., Alarifi, S., & Alessa, H. (**2022**). Prenatal breastfeeding self-efficacy. *International Journal of Environmental Research and Public Health, 19*(7), 4115.
28. Holgerson, P. L., Vestman, N. R., Claesson, R., et al. (**2013**). Oral microbial profile in infants. *Journal of Pediatric Gastroenterology and Nutrition, 56*(2), 127–136.
29. Lee, L. C., Liong, C. Y., & Jemain, A. A. (**2018**). PLS-DA for high-dimensional data. *Analyst, 143*(15), 3526–3539.
30. Dattilo, A. M., & Saavedra, J. M. (**2019**). Nutrition education strategies. *Nestlé Nutrition Institute Workshop Series, 92*, 1–18.
31. Erbil, D. G. (**2020**). Flipped classroom and cooperative learning. *Frontiers in Psychology, 11*, 1157.
32. Oudat, Q., Lee, R. C., Miller, E. L., Couch, S. C., & Bakas, T. (**2025**). Feeding practices of caregivers. *Children, 12*(2), 226.
33. Villacura-Herrera, C., Pérez, J., Jones, P. B., & Núñez, D. (**2024**). CAPE reliability meta-analysis. *Psychiatry Research, 338*, 115988.
34. Goldshtein, I., Sadaka, Y., Amit, G., et al. (**2025**). Breastfeeding duration and child development. *JAMA Network Open, 8*(3), e251540.
35. Borghi, E., & Sachdev, H. S. (**2024**). Growth standards in children. *American Journal of Clinical Nutrition, 120*(4), 764–768.
36. Alissa, N., & Alshareef, M. (**2024**). Factors influencing exclusive breastfeeding. *Healthcare, 12*(6), 639.
37. World Health Organization & UNICEF. (**2023**). *Global breastfeeding scorecard 2023*. Geneva: WHO.
38. Nazareth, M., Pinto, E., Severo, M., Graça, P., Lopes, C., & Rêgo, C. (**2024**). Early feeding practices in Portugal. *Porto Biomedical Journal, 9*(2), 250.
39. Ortega-Ramírez, A. D., Maneschy, I. R., Miguel-Berges, M. L., et al. (**2024**). Early feeding practices in preschool children. *Maternal & Child Nutrition, 20*(4), e13672.
40. Guajardo-Villar, A., Pelat, C., Blondel, B., et al. (**2024**). Baby-Friendly Hospital Initiative impact. *International Journal of Epidemiology, 53*(3), dyae080.
41. Abusabah, A. M., Sr., Derkaoui, H. R., Abusebah, H. M., et al. (**2024**). Exclusive breastfeeding in Aseer region. *Cureus, 16*(8), e66788.
42. Agampodi, T. C., Dharmasoma, N. K., Koralagedara, I. S., et al. (**2021**). Barriers to breastfeeding in Sri Lanka. *International Breastfeeding Journal, 16*(1), 32.
43. Kebede, S. D., Forster, E. M., Agmas, K., Aytenew, T. M., & Creedy, D. K. (**2025**). Early breastfeeding initiation in Ethiopia. *BMC Public Health, 25*(1), 1377.
44. Sandhi, A., Nguyen, C. T. T., Lin-Lewry, M., Lee, G. T., & Kuo, S. Y. (**2023**). Breastfeeding education interventions. *Nurse Education Today, 126*, 105813.
45. McFadden, A., Siebelt, L., Marshall, J. L., et al. (**2019**). Counseling interventions for breastfeeding. *International Breastfeeding Journal, 14*, 42.
46. Gohal, G., Mustafa, M., Al-Makramani, A. A. A., et al. (**2023**). Barriers of exclusive breastfeeding in Saudi Arabia. *Journal of Family Medicine and Primary Care, 12*(2), 295–304.

47. Ayton, J., Pearson, S., Graham, A., Kitsos, G., & Hansen, E. (**2025**). Breastfeeding and return to work. *Maternal & Child Nutrition, 21*(1), e13761.
48. Esmaeel, S. E., Alobaidan, R. K., Alenezi, D. F. K., et al. (**2025**). Breastfeeding barriers in Saudi Arabia. *Belitung Nursing Journal, 11*(6), 749–760.
49. Brugaillères, P., Deguen, S., Lioret, S., et al. (**2024**). Maternal employment and breastfeeding. *International Breastfeeding Journal, 19*(1), 38.
50. Davanzo, R., & Baldassarre, M. E. (**2024**). Infant growth spurts and milk supply. *Nutrients, 16*(21), 3657.
51. Esteves, G., Sandow, A., Segbedji, C., et al. (**2025**). Relational influences on breastfeeding in Ghana. *Maternal & Child Nutrition, 21*(4), e70080.
52. Dessie, A., Zeru, M. A., Zike, D. T., & Mitku, A. A. (**2025**). Pre-lacteal feeding practices in Ethiopia. *BMC Public Health, 25*(1), 3918.