Review Article

Preterm Infant Enteral Feeding Practices in Saudi Arabia: A Scoping Review

Wesam A. Alyahya, Rayhana H. Alsharfa, Noor A. Alduhbaki, Batool N. Al-Zahir, Marwa A. Alqalaf, Hussah M. Altwejry, Hanoof A. Alessa, Jumanah S. Alawfi, Shakil A. Ahmad[1]

Department of Clinical Nutrition, College of Applied Medical Sciences, [1]Directorate of Library Affairs, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

Abstract

Background: Preterm infants are at risk of developing nutritional deficiencies, which is further compounded by the fact that providing them with adequate nutrition is often challenging. Enteral feeding (EF) practices vary across neonatal units and can be impacted by the setting and geographical region. There is also a lack of evidence on best practices.

Objective: To investigate EF practices and related nutrition factors, patterns, and outcomes in preterm infants in Saudi Arabia by examining studies published in this area.

Methods: A search was conducted for articles on EF practices among preterm infants in Saudi Arabia that were published between January 2010 and May 2024. Searches were carried out across five electronic databases and through searching inward and backward citation and reference lists of relevant papers. Studies that described or assessed EF practices used in preterm infants from any region of Saudi Arabia and were published in English or Arabic were included.

Results: The database and manual search resulted in 1905 articles. After removing duplicates and applying the inclusion/exclusion criteria, 14 publications were included: 12 were observational studies, 1 was a conference abstract (with retrospective analysis), and 1 was a commentary. Of these, 7 studies were conducted in the Central Province, 6 in the Western Province, and 1 in the Eastern Province. More than half of the publications (8 of 14) were published between 2021 and 2023. The studies included were categorized to three themes based on their aim: studies describing practices on mother–infant bond to encourage breastfeeding, assessing nutritional status and EF, and assessing EF as a risk factor for developing prematurity complications.

Conclusion: While research activity on EF practices in Saudi Arabia has increased very recently, yet there is a paucity of studies, particularly experimental studies that focus on both short- and long-term health outcomes.

Keywords: Enteral feeding, feeding practice, preterm infants, Saudi Arabia

Address for correspondence: Dr. Wesam A. Alyahya, 2835 King Faisal Road, Post Office Box 2435, Dammam 31441, Saudi Arabia.
E-mail: waalyahya@iau.edu.sa

Submitted: 03-Dec-2023 **Revised:** 03-Jun-2024 **Accepted:** 04-Jul-2024 **Published:** 12-Oct-2024

Access this article online	
Quick Response Code:	Website: https://journals.lww.com/sjmm
	DOI: 10.4103/sjmms.sjmms_637_23

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Alyahya WA, Alsharfa RH, Alduhbaki NA, Al-Zahir BN, Alqalaf MA, Altwejry HM, *et al*. Preterm infant enteral feeding practices in Saudi Arabia: A scoping review. Saudi J Med Med Sci 2024;12:275-83.

INTRODUCTION

Postnatal nutritional status is an important factor that affects both short- and long-term health outcomes in preterm infants.[1] Many preterm infants experience nutritional deficiency and growth restriction during their hospital stay,[2,3] which are potentially associated with poorer in-hospital and neurodevelopmental outcomes.[4,5] Enteral feeding (EF) is used to deliver nutrients to preterm infants, and providing optimal EF is critically important to the health of preterm infants. However, it can be difficult to establish successful EF in preterm infants with feeding intolerance and the risk of necrotizing enterocolitis (NEC), which may delay EF initiation and advancement. Delay in establishing EF leads to prolonged use of total parenteral nutrition and central lines, which may increase the risk of infection and gastrointestinal disuse.[6] In addition, EF practices vary, and this reflects in the fact that there is currently insufficient evidence available to inform optimal EF practices.

It is well established that mother's own milk is the optimal form of nutrition for all infants. Consuming mother's own milk provides special benefits for very low birth weight (VLBW) preterm infants and, most importantly, reduces the incidence of NEC.[7] However, for some preterm infants, the supply of mother's own milk may not be sufficient due to factors such as lack of lactation support[8] or mother–infant separation.[9] In such cases, the American Academy of Pediatrics recommends using donated human milk (DHM) as an alternative or to supplement the available mother's own milk.[10] It is used in neonatal units in many countries, including the United Kingdom[10] and the United States.[11] In Western countries, the DHM used in neonatal units is pasteurized and processed in milk banks.[10] In Muslim countries, the use of DHM is not widespread but is gradually increasing; it is only possible to use DHM when Islamic jurisprudential guidelines regarding milk kinship are implemented.[12]

Availability of DHM has been reported to influence the initiation time of EF in VLBW infants. Units with access to DHM initiate EF earlier than units with no access to DHM[7] due to the increased risk of NEC when formula is used compared with DHM.[13] Furthermore, human milk (mother's own milk or DHM) alone does not meet the nutritional requirements of preterm infants (110–135 kcal/kg/day), which are higher than those of full-term infants (108 kcal/kg/day).[14] Therefore, human milk is often fortified using a human milk fortifier to increase its nutritional density. However, optimal fortification strategies that specify, for example, when to initiate fortification and for how long, have not yet been determined.[15] The results of an international survey on EF showed that there was considerable variability in EF practices across four geographical regions.[7]

Hence, there is a need to identify optimal EF practices in diverse preterm infant populations and geographical regions. The aim of this scoping review was to investigate EF practices and related nutrition factors, patterns, and outcomes in preterm infants in studies conducted in Saudi Arabia to inform local research directions.

METHODS

This study has been reported as per the Preferred Reporting Items for Scoping Reviews (PRISMA-ScR) (2018) reporting guidelines.[16] One Figure was created using VOS viewer for bibliometric mapping.[17]

Inclusion criteria

Studies were included if they were related to preterm infant (born <37 weeks) feeding practices (whether focused on the preterm infants or the feeding experience of neonatal intensive care unit [NICU] staff), were conducted in Saudi Arabia, and were published 2010 onward. As the aim of this study was to explore research output on EF from Saudi Arabia, there were no restrictions on study design, and commentaries and review articles were also considered. Abstracts and conference proceedings were considered for inclusion only if they contained the required information. Studies that only focused on full-term infants, were conducted on animals, were conducted outside Saudi Arabia, or were published before 2010 were excluded.

Literature search

Five databases—PubMed, Scopus, Web of Science, Medline, and Dimensions—and Citation chaser (for inward and backward citations) were searched, and articles published between January 2010 and May 2024 were retrieved. The reference lists of the most relevant papers and reviews were also manually searched to identify articles that may not have been retrieved during the electronic database search. The search strategy was developed in consultation with a librarian.

The following MeSH terms were used: "Enteral Nutrition," "Infant, Extremely Premature," and "Saudi Arabia." The keywords were "EF," "preterm," and "Saudi." We utilized Boolean operators (AND, OR) to connect the search terms [Supplementary Table 1].

Study selection and data extraction

Screening of studies titles and abstracts, if necessary, was distributed to the investigators and at least two independent

reviewers screened each article (WA, HT, RA, NA, BA, and MA), following which three reviewers (WA, BA, and MA) independently assessed the full texts of the potentially relevant papers. Two reviewers (WA and HT) checked the excluded studies.

Data on the following parameters were extracted using a data extraction sheet and included authors' names, study settings, year of publication, location, study objective, study design, characteristics of participants, inclusion and exclusion criteria, feeding practice described or evaluated, and outcomes measured. Data were entered into Microsoft Excel and are represented in tables and figures.

RESULTS

Literature search

The initial literature search retrieved a total of 1905 articles, of which 1643 were from the five databases and 262 were from subsequent search using inward backward citation. After removing duplicate articles, the titles of the remaining 1059 articles were screened for relevance, and 1042 articles were subsequently excluded. The full text of 17 articles were assessed, from which 14 articles met the eligibility criteria and were included [Figure 1]. Of these, 12 articles were observational studies, 1 was a conference abstract (with retrospective analysis), and 1 was a commentary.

Characteristics of the included articles

The key characteristics of the included articles are described in Table 1. The articles were published between 2010 and 2023; 4 articles were published in 2021 and 2 each in 2022 and 2023. The citation count exhibited significant variability, with a peak of 60 citations in 2011, followed by a decrease in the subsequent years [Figure 2]. This trend suggests fluctuations in the impact of these publications over the years. Of the 14 publications, 7 were conducted in the Central Province, 6 in the Western Province, and 1 in the Eastern Province; no such studies were conducted in the Northern and Southern Provinces.

The most frequent and relevant terms in a dataset concerning neonatal care in Saudi Arabia were "Saudi Arabia" and "skin-to-skin contact (SSC) knowledge" by occurrence and "Parent" and "Kangaroo Care" by high relevance. Noteworthy terms such as "Mother," "Skin," and "Nurse" also feature prominently, indicating a focus on family and healthcare providers. This underscores significant topics like "Exclusive Breastfeeding" and "Low Birth

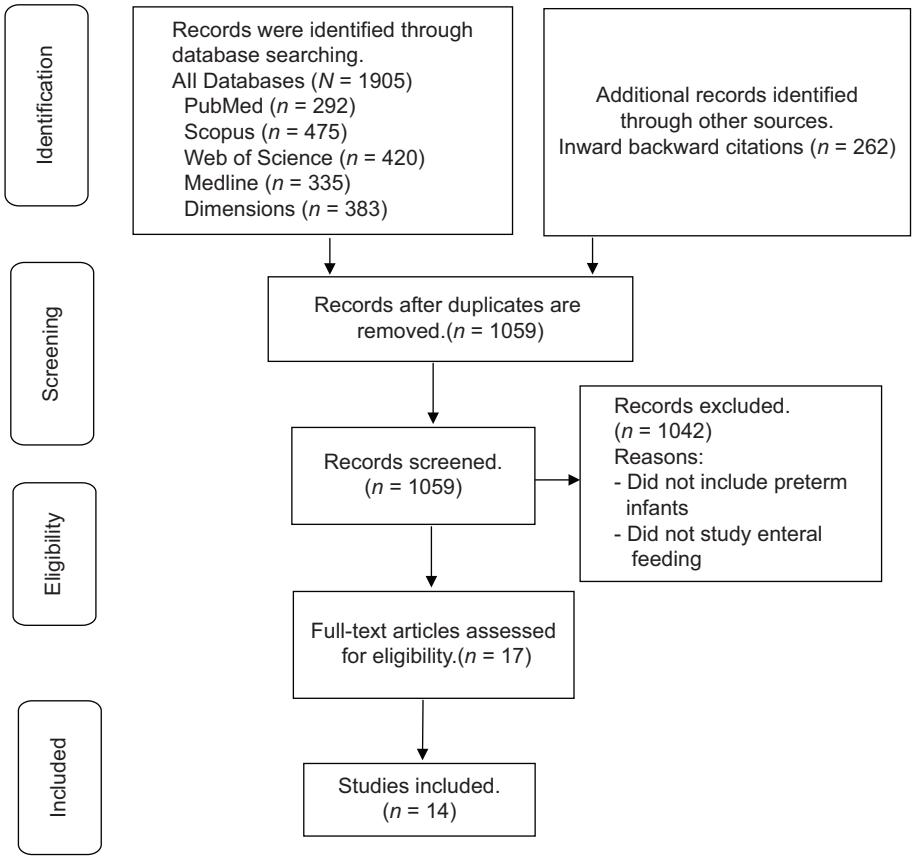

Figure 1: PRISMA flowchart

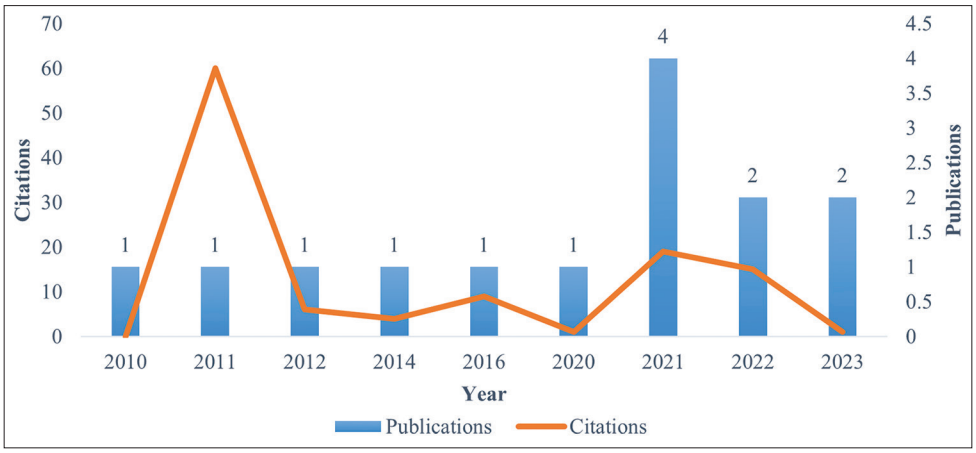

Figure 2: Number of publications and citations on preterm infant feeding practices by year (2010-2023)

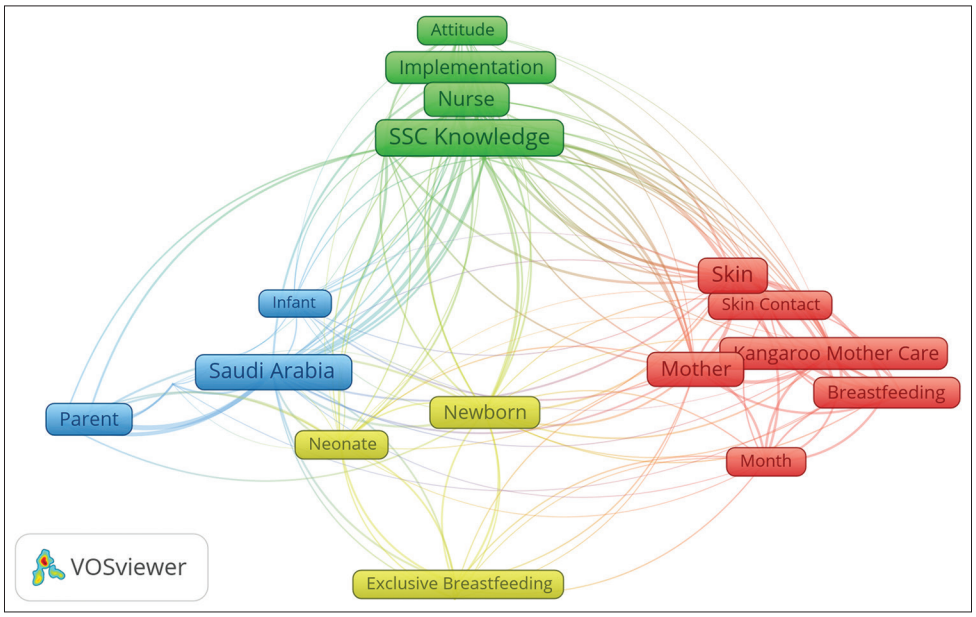

Figure 3: Common keywords

Weight (LBW) Infant," pointing to critical areas in neonatal care [Figure 3].

Categorization of studies based on aims

The aims of the included studies (n = 14) were broadly categorized into three main areas of focus: evaluating EF and nutritional status in preterm infants,[18-21] evaluating practices that encourage breast milk production,[22-25] and determining the prevalence of neonatal complications and its related risk factors.[26-31]

In studies that assessed nutritional status and EF in preterm infants, one study described the early exposure of cow's milk in preterm infants and found that the majority of the preterm infants were mixed fed during their early stage of life and none were exclusively breastfed compared with 6.6% term infants.[20] One study assessed the adequacy of nutrition support on neonatal outcomes and found that extremely LBW (ELBW) infants exhibited significantly lower body mass index compared with the more mature infants (VLBW and LBW).[18] Another study assessed growth in relation to biochemical status and found no significant difference in complete blood count and serum electrolytes between the different gestational age categories, except for albumin, which was significantly lower in ELBW.[19]

Four studies were designed to evaluate the knowledge and practices related to mother–infant bond to facilitate breastfeeding, such as kangaroo mother care (KMC) and SSC perception, among parents[24] and NICU nurses.[22,23,25] The overall results from those studies showed that the parents had an average knowledge score of 12.7/16 and NICU nurses

Table 1: Description of the included articles (*n*=14)

#	Study Study design	City (Province)	Aim	*n*	Participants	Outcome type	Results
1	Al-Matary *et al*., 2023[24] Cross sectional	Riyadh (Central)	Evaluate the perception of parents towards the practice of KMC with their newborns in Saudi Arabia, especially in pre-term children.	51	Parents of preterm infants	Short term NICU KMC	Parents perception on KMC The average score 12.73±3.29 (score range: 0–16)
2	Almutairi 2022[25] Cross sectional	Jeddah (Western)	Describe and determine relationships between knowledge, education, beliefs/attitudes, and the implementation of SSC between mother and infant	40	NICU nurses	Short term NICU SSC	Relationship between nurses' knowledge and implementation on SSC Once nurses have improved their knowledge, education, and beliefs/attitudes, SSC implementation may increase.
3	Al Mutair *et al*., 2023[22] Cross sectional	Al-Ahsa (Eastern)	Evaluate knowledge, attitude and implementation of Skin-to-Skin Care among nurses and to assess the implementation of SSC in the perinatal setting.	93	NICU nurses	Short term NICU SSC	Relationship between nurses' knowledge and implementation on SSC Correlation coefficient revealed a significant association between the total educational years of nursing degree and SSC (*P*=0.02).
4	Bamehrez 2022[28] Retrospective cohort	Jeddah (Western)	To investigate the incidence of hyponatremia in preterm infants. The secondary aim was to determine the risk factors of late-onset of hyponatremia and their influence on neonatal outcomes.	71	Moderate-late Preterm	Short term NICU Incidence of hypernatremia and risk factors	Incidence of hypernatremia Incidence (27%) Risk factors Exclusive breastfeeding was significantly associated with late inset hypernatremia (*P*<0.001)
5	Atwah *et al*., 2021[20] Retrospective cohort	Jeddah (Western)	Evaluate the prevalence of early exposure to cow's milk formula in the nursery of a tertiary care hospital	894	All infants admitted to the nursery Term (*n*=843) Moderate-late preterm (*n*=51)	Short term NICU Early feeding pattern Exposure to cow's milk formula	All infants Early feeding pattern 839 (93.7%) received cow's milk formula 797 (89.1%) received mixed feeding 56 (6.3%) received exclusive breastfeeding Preterm (*n*=51) None were exclusive breastfed 96.1% received mixed feeding
6	Bawazeer *et al*., 2021[29] Cross sectional	Riyadh (Central)	Determine the rate of neonatal hospital readmission and to identify the associated factors	570	All infants readmitted to the hospital Term (*n*=501) and Preterm (*n*=69)	Post NICU/nursery discharge Hospital readmission	Readmission Total preterm readmitted after discharge (12.1%) 34.8% readmitted ≤7 days 65% readmitted >7 days Predictors of readmissions Formula feeding increases readmission at age >7 days: RR 2.4 (95% CI 1.3-6.4) *P*=0.011
7	Al-Matary *et al*., 2021[30] Prospective data collection	Riyadh (Central)	The potential effects of vitamin D deficiency on respiratory distress syndrome among preterm infants	174	Moderate-late pretermwith 25-hydroxyvitamin D (25OHD) serum level ≤30 ng/ml at 24 h of life or less.	Short term NICU Respiratory distress syndrome severity	Respiratory distress syndrome Respiratory distress syndrome was statistically significantly higher at vitamin D deficiency infants.
8	Al-Shehri *et al*., 2021[23] Cross sectional	Riyadh (Central)	To assess the levels of knowledge and competency regarding KMC among nurses and to identify the potential barriers to practice.	209	NICU Nurses	Short Term NICU Knowledge and competency regarding KMC	Knowledge and perception of nurses regarding KMC Promote maternal-infant bonding (4.47±1.3) Enhancing successful breastfeeding (4.44±0.9) Nurses encouraged parents to perform KMC (92.8%) Provided sufficient information to optimize practice (90%) Barriers to KMC practice reported by nurses Fear of accidental extubation Lack of time due to workload Familial reluctance to initiate KMC Lack of privacy during KMC practice

Contd...

Table 1: Contd...

#	Study Study design	City (Province)	Aim	*n*	Participants	Outcome type	Results
9	Al-Mouqdad *et al*., 2020[27] Retrospective cohort	Riyadh (Central)	Assess antenatal care of mothers and neonatal outcomes among premature Saudi and non-Saudi infants, and investigate possible reasons for disparities	755	Very preterm and birthweight <1500 g Groups Saudi (*n*=437) Non-Saudi (*n*=318)		Feeding Saudi infants had significantly less EBM compared to non-Saudi infants (34 vs 48%, *P*<0.001). Infants' morbidities Higher morbidities in non-Saudi compared to Saudi groups including: BPD (32 vs. 22%, *P*=0.002) IVH (35 vs. 28%, *P*=0.03) NEC (34 vs. 22%, *P*<0.001) PDA (63 vs. 50%, *P*<0.001)
10	Kensara *et al*., 2016[19] Prospective data collection	Makkah (Western)	To assess the nutritional status of LBW infants from immediately after birth	300	Moderate-late preterm and LBW (<2 kg) Groups LBW (*n*=100) VLBW (*n*=100) ELBW (*n*=100)	Short Term NICU Growth and biochemical lab values	Biochemical values CBC and serum electrolytes were comparable Only serum albumin was significantly lower in ELBW compared to VLBW and LBW infants (*P*<0.05)
11	Azzeh *et al*., 2014[18] Cross sectional	Makkah (Western)	To assess the effect of hospital nutrition support on growth velocity and nutritional status of LBW infants at Al-Noor hospital, Saudi Arabia	300	Moderate-late preterm and LBW (<2 kg) Groups Categorized into LBW, VLBW, and ELBW	Short Term NICU	Anthropometric BMI was significantly lower in VLBW and ELBW compared with LBW groups. Growth velocity was not significantly different between the three groups, ranged (8.7 to 10.2 g/kg/d, *P*>0.05) Biomedical Biochemical indicators were remarkably improved in all groups (*P*<0.05).
12	Al Hazzani 2012[21] Commentary	Riyadh (Central)	Comment on ADEPT multi multicenter randomized controlled trial conducted in the United Kingdom and Ireland to evaluate the effects of an "early" enteral feeding regimen compared to one of "late" enteral feeds	NA	NA	NA	NA
13	Al Hazzani *et al*., 2011[31] Prospective data collection	Riyadh (Central)	Describe and analyze the outcomes of VLBW infants admitted to NICU at KFSH and to compare the results with data published by the NICHD (published 2007).	186	Very preterm KFSH (*n*=186) NICHD (27) (Ref group)	Short Term NICU	Antenatal steroids given to mothers (74%) Infants born by caesarean section (85%) -Infants' morbidities Comparable outcomes between KFSH vs. NICHD PDA (31 vs. 29%) IVH (13 vs. 27%) NEC (7.5 vs, 7%) LOS (22 vs. 22%) Survival (83 vs. 85%).
14	Abdulrahim *et al*., 2010[26] (Abstract only) Retrospective data collection	Jeddah (Western)	To detect the prevalence and risk factors of severe retinopathy of prematurity	218	Very preterm	Short Term NICU Severe ROP	Prevalence of severe ROP Severe ROP rate=14.3% Significant risk factors Ventilation (*P*<0.001) Gestational age and birth weight (*P*<0.0001)

LBW: low birth weight, VLBW: very low birth weight, ELBW: extremely low birth weight, EBM: expressed breast milk, BPD: bronchopulmonary dysplasia, IVH: Intraventricular hemorrhage, NEC: necrotizing enterocolitis, PDA: Patent ductus arteriosus, NICU: intensive care unit, KFSH: King Faisal Specialist Hospital, NICHD: National Institute of Child Health and Development, ROP: retinopathy of prematurity, LOS: late onset sepsis, KMC: kangaroo mother care, SSC: skin to skin contact. Preterm infants classification: moderate to late preterm=32–37 weeks, very preterm: <32 weeks, extremely preterm: <28 weeks

have a good level of knowledge regarding these practices. These studies found that nurses' work experience and level of education (postgraduate studies) were factors associated with increased implementation of these practices.

The remaining studies described prevalence of some neonatal complications and related risk factors where feeding was considered as a variable.[26,28-30] These studies outlined the prevalence of several complications including late-onset hyponatremia and neonatal in-hospital morbidities such as retinopathy of prematurity (ROP). One study found that vitamin D deficiency was associated with respiratory distress syndrome.[30] Bamehrez found

that among preterm infants, exclusive breastfeeding was a significant factor associated with late-onset hyponatremia.[28] In contrast, Bawazeer *et al.*[29] studied neonatal readmission rates and their risk factors and found that exclusively formula-fed neonates were three times more at risk of a 7-day readmission compared with exclusively breastfed neonates. A study that assessed ROP among neonates of gestational age ≤32 weeks found that there were no cases of ROP among those exclusively breastfed (14% of the population), with the authors suggesting that breastfeeding may have a protective effect on ROP.[26] Another study that compared Saudi and non-Saudi neonates of gestational age ≤32 weeks and ELBW and found significant difference in the NICU interventions between the two groups, with non-invasive ventilator and umbilical arterial catheter use being significantly higher in Saudi neonates and peripherally inserted central catheter, omeprazole, and EBM use being higher in non-Saudi neonates.[27]

Categorization of Studies based on Study Outcomes

Most of the included studies analyzed short-term in-hospital outcomes such as feeding patterns, SSC, growth, and neonatal morbidities. The reported morbidities included bronchopulmonary dysplasia, intraventricular hemorrhage, NEC, patent ductus arteriosus, and late-onset sepsis. Growth outcomes included weight gain velocity, weight gain, and body mass index. Neither head circumference nor length change was measured in any of the studies. Feeding outcomes included the rate of breastfeeding compared to formula feeding at the time of hospital discharge and weeks after discharge. Only one study measured factors associated with neonatal readmission after NICU discharge.[29]

One study assessed neonatal outcomes in relation to the antenatal care provided to Saudis versus non-Saudis and found disparities in the antenatal care to mothers in both groups, but no difference in the mortality rates among neonates.[27] Another study compared neonatal outcomes of very preterm Saudi infants and compared them with international prevalences of outcomes.[31] One publication was a commentary on an interventional study on early versus delayed progression of EF in preterm infant that was done in the United Kingdom. This commentary provided insight to state that there is no clear benefit in delaying EF in preterm infants of <34 weeks of gestation.[21]

The number of participants in each study ranged from 40 NICU nurses to 894 infants. The study with the largest sample of preterm infants was conducted by Al-Mouqdad *et al.*[27] in Riyadh. A wide cohort of preterm infants were sampled: 6 of 9 studies included with moderate to late preterm infants, and 3 studies included very preterm infants (<32 weeks). Al Hazzani *et al.*[31] compared the prevalences of outcomes of Saudi VLBW infants with those published by the National Institute of Child Health and Development, United States, and found that Saudi infants had the comparable outcomes.

DISCUSSION

Preterm infants need special nutritional care to achieve optimal growth and development outcomes. Therefore, it is vital to determine the optimal feeding strategies, including the use of EF. However, there are challenges associated with establishing safe and adequate EF. Furthermore, cultural practices, demographics, and healthcare systems can influence the success of EF, and thus must be considered when developing best EF practices for specific populations. The aim of this scoping review was to investigate the research conducted and published in this field in Saudi Arabia.

The main finding of this review is that a limited number of studies have described and investigated EF practices in preterm infants in Saudi Arabia. Despite the aim of this scoping review being very broad, and a comprehensive search strategy, very few studies were found. Notably, all 13 studies were observational, with none being experimental. Further, 11 studies (>90%) were conducted in the Central and Western regions, and thus are not representative of the demographic characteristics and healthcare systems of Saudi Arabia. Therefore, there is a need for conducting experimental and observational research in more varied provinces across the country. Nonetheless, >50% of the included articles were published between 2021 and 2023 [Figure 2], indicating that research around this topic may be gathering pace in Saudi Arabia, which is one of the most important countries in the Middle East in terms of research, including in the health sector.[19,32]

It is also worth noting that the dearth of studies on EF practices in preterm infants is not only limited to Saudi Arabia, but also worldwide. Many of the systematic reviews of EF practices have included comments about the relatively low number of available studies and lack of evidence. For example, a systematic review designed to analyze the timing of introducing human milk fortification to EBM in preterm infants found only two clinical trials.[21] Similarly, a recent Cochrane review that assessed early EF in preterm infants found only six studies.[33]

The lack of studies on optimal EF practices is evidenced by the variation in EF practices, which can strongly impact neonatal outcomes. A study involving 1387 infants found that variation in EF practices was directly associated with

postnatal growth restriction, prolonged trophic feeds before advancing, and time of feeding initiation.[33,34] Variation in EF practices has been reported in many countries, including Australia, Canada, Denmark, Ireland, New Zealand, Norway, Sweden, and the United Kingdom.[7] The variation observed in EF practices reflects the lack of evidence for optimal EF practices in preterm infants. Therefore, our findings highlight the need to 1) conduct studies on EF in varied contexts, 2) identify and define the current preterm infant population, 3) determine the best feeding strategies for preterm infants, and 4) place greater emphasis on neonatal nutrition research by health and research institutes.

A study that examined early exposure to cow's milk among a cohort of 894 infants, including 51 preterm infants, found that no preterm infants were exclusively breastfed, and even among full-term infants, only 6.3% were exclusively breastfed.[20] These concerning findings underscore the significant challenges in maintaining exclusive breastfeeding, especially for vulnerable preterm infants, and indicate the need for efforts to increase the rate of breastfeeding owing to its widely reported benefits. A systemic review found that the incidence of NEC was significantly lower in preterm infants fed exclusive human milk than that of partial human milk in a dose–response manner (risk ratio = 0.54, 95% confidence interval [95% CI]: 0.36–0.79; $P < 0.05$).[35] Another study showed that preterm infants who were exclusively formula fed had significantly higher risk of readmission than those exclusively breastfed (risk ratio = 2.4, 95% CI: 1.3–6.4; $P = 0.011$).[29]

All of the included studies, except one that assessed readmission rate, were limited to short-term outcomes of preterm infants during their stay in NICU. While in-hospital outcomes are important, this finding highlights the need to assess long-term outcomes such as neurodevelopment, which can affect preterm infants' quality of life and put burden on healthcare system. According to a survey, the top 12 outcomes reported by parents, patients, healthcare staff and stakeholders included both short- and long-term outcomes with equal importance.[36] However, given the low number of studies currently available on this important topic, there is need for policymakers to devise strategies to address this gap in the literature.

A strength of this review is that it was designed to capture a wide range of literature to enable a comprehensive study of the EF practices used in Saudi Arabia. A general search was performed, and any study on preterm infants was included; there were no restrictions on the study design to maximize the search sensitivity. Several databases were searched using a refined search strategy and additional snowballing of the included study was done to capture maximum number of the available literature. Of note, as the review was focused on studies from Saudi Arabia, the findings may have limited generalizability in other healthcare settings. A limitation of this study is that grey literature searches were not carried out, as well as some studies that may not have been published in the searched databases may have been overlooked.

CONCLUSION

This scoping review highlights the paucity of published research on enteral feeding practices in Saudi Arabia, thereby highlighting the need for additional research, both observational and experimental, on this topic.

Peer review

This article was peer-reviewed by two independent and anonymous reviewers.

Data availability statement

Data sharing is not applicable for this article, as no new data were created or analyzed.

Author contributions

Conceptualization: W.A.A., R.H.A, N.A.A, B.N.A, M.A.A, H.M.A, H.A, A, J.S.A.; Methodology: W.A.A., R.H.A, N.A.A, B.N.A, M.A.A, and S.A.A.; Data analysis: W.A.A., R.H.A, N.A.A, B.N.A, M.A.A, H.M.A, J.S.A.; Writing–original draft preparation: W.A.A., R.H.A, N.A.A, B.N.A, M.A.A, H.M.A, H.A, A, J.S.A; Review and editing: W.A.A., J.S.A, S.A.A; Supervision: W.A.A, H.A.A, H.M.A, J.S.A.

All authors have read and agreed to the published version of the manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Lucas A. Long-term programming effects of early nutrition -- implications for the preterm infant. J Perinatol 2005;25 Suppl 2(S2):S2-6.
2. Ehrenkranz RA, Younes N, Lemons JA, Fanaroff AA, Donovan EF, Wright LL, *et al.* Longitudinal growth of hospitalized very low birth weight infants. Pediatrics 1999;104 (2 Pt 1):280-9.
3. Mactier H, Mokaya MM, Farrell L, Edwards CA. Vitamin A provision for preterm infants: are we meeting current guidelines? Arch Dis Child Fetal Neonatal Ed 2011;96:F286-9.
4. Ehrenkranz RA, Dusick AM, Vohr BR, Wright LL, Wrage LA, Poole WK. Growth in the neonatal intensive care unit influences

neurodevelopmental and growth outcomes of extremely low birth weight infants. Pediatrics 2006;117:1253-61.
5. Hintz SR, Kendrick DE, Stoll BJ, Vohr BR, Fanaroff AA, Donovan EF, *et al.* Neurodevelopmental and growth outcomes of extremely low birth weight infants after necrotizing enterocolitis. Pediatrics 2005;115:696-703.
6. Menon G, Boyle EM, Embleton ND, McIntosh N. Introduction of enteral feeds in preterm infants. Pediatrics 2004;114:327-8.
7. Klingenberg C, Embleton ND, Jacobs SE, O'Connell LA, Kuschel CA. Enteral feeding practices in very preterm infants: an international survey. Arch Dis Child Fetal Neonatal Ed 2012;97:F56-61.
8. Sankar MN, Weiner Y, Chopra N, Kan P, Williams Z, Lee HC. Barriers to optimal breast milk provision in the neonatal intensive care unit. J Perinatol 2022;42 (8):1076-82.
9. Abugov H, Ochoa Marin SC, Semenic S, Arroyave IC. Barriers and facilitators to breastfeeding support practices in a neonatal intensive care unit in Colombia. Invest Educ Enferm 2021;39:e11.
10. Alyahya W, Barnett D, Cooper A, Garcia AL, Edwards CA, Young D, *et al.* Donated human milk use and subsequent feeding pattern in neonatal units. Int Breastfeed J 2019;14:39.
11. Boundy EO, Anstey EH, Nelson JM. Donor human milk use in advanced neonatal care units-United States, 2020. MMWR Morb Mortal Wkly Rep 2022;71:1037-41.
12. Khalil A, Buffin R, Sanlaville D, Picaud JC. Milk kinship is not an obstacle to using donor human milk to feed preterm infants in Muslim countries. Acta Paediatr 2016;105:462-7.
13. Quigley M, McGuire W. Formula versus donor breast milk for feeding preterm or low birth weight infants. Cochrane Database Syst Rev 2014:CD002971.
14. Agostoni C, Buonocore G, Carnielli VP, De Curtis M, Darmaun D, Decsi T, *et al.* Enteral nutrient supply for preterm infants: commentary from the European Society of Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. J Pediatr Gastroenterol Nutr 2010;50:85-91.
15. Brown JV, Lin L, Embleton ND, Harding JE, McGuire W. Multi-nutrient fortification of human milk for preterm infants. Cochrane Database Syst Rev 2020;6:CD000343.
16. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, *et al.* PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med 2018;169:467-73.
17. Van Eck N, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. scientometrics 2010;84:523-38.
18. Azzeh FS, Alazzeh AY, Dabbour IR, Jazar AS, Obeidat AA. Effect of hospital nutrition support on growth velocity and nutritional status of low birth weight infants. Nutr Hosp 2014;30:800-5.
19. Kensara OA, Azzeh FS. Nutritional status of low birth weight infants in Makkah region: Evaluation of anthropometric and biochemical parameters. J Pak Med Assoc 2016;66:414-7.
20. Atwah AF, Koshak EA, Alhussaini BH, Alsaedi SA. The prevalence and trends of the early introduction of cow milk to newborns at tertiary care center: a risk of atopy. International Journal of Environmental Research and Public Health 2021;18:6686.
21. Al Hazzani F. Early or delayed enteral feeding for preterm growth-restricted infants: a randomized trial. J Clin Neonatol 2012;1:181-3.
22. Al Mutair A, Almutairi W, Aljarameez F, Kay E, Rabanal R, Abellar K, *et al.* Assessment of nurses' knowledge, attitude and implementation of skin-to-skin care within the perinatal setting in Saudi Arabia: Survey study. Nurs Open 2023;10:2165-71.
23. Al-Shehri H, Binmanee A. Kangaroo mother care practice, knowledge, and perception among NICU nurses in Riyadh, Saudi Arabia. Int J Pediatr Adolesc Med 2021;8:29-34.
24. Al-Matary A, Al-Matary M, DelaCena S, AlJohani E. Perception of parents in experiencing kangaroo care in Saudi Arabia. Journal of Neonatal Nursing 2023;29:652-6.
25. Almutairi WM. Survey of Skin-to-Skin Contact with Obstetrics and Pediatric Nurses. Nurs Rep 2022;12:13-21.
26. Abdulrahim M, Montasser M, Al-Seoud AM, El Metwally D. 1174 Risk Factors for Retinopathy of Prematurity Among Preterm in One of the Largest Saudi's Western Region Neonatal Intensive Care Units. Pediatr Res 2010;68:581.
27. Al-Mouqdad M, Abdelrahim A, Alodhaidan NA, Sumaily HH, Khalil TM, Asfour Y, *et al.* Antenatal care of mothers and morbidity and mortality disparities among preterm Saudi and non-Saudi infants less than or equal to 32 weeks' gestation. Ann Saudi Med 2020;40:290-7.
28. Bamehrez M. Incidence of Hyponatremia and Associated Factors in Preterm Infants in Saudi Arabia. Cureus 2022;14:e23869.
29. Bawazeer M, Alsalamah RK, Almazrooa DR, Alanazi SK, Alsaif NS, Alsubayyil RS, *et al.* Neonatal hospital readmissions: Rate and associated causes. J Clin Neonatol 2021;10:233-8.
30. Al-Matary A, AlMalki Y, Khalil S, AlHulaimi E. The potential effects of vitamin D deficiency on respiratory distress syndrome among preterm infants. Clinical Nutrition ESPEN 2021;44:243-6.
31. Al Hazzani F, Al-Alaiyan S, Hassanein J, Khadawardi E. Short-term outcome of very low-birth-weight infants in a tertiary care hospital in Saudi Arabia. Ann Saudi Med 2011;31:581-5.
32. Nature Index. Saudi Arabia China: Nature; 2024 [Available from: https://www.nature.com/nature-index/country-outputs/Saudi%20Arabia. [Last accessed on 2024 Aug 15].
33. Walsh V, Brown JVE, Copperthwaite BR, Oddie SJ, McGuire W. Early full enteral feeding for preterm or low birth weight infants. Cochrane Database Syst Rev 2020;12:CD013542.
34. Stevens TP, Shields E, Campbell D, Combs A, Horgan M, La Gamma EF, *et al.* Variation in Enteral Feeding Practices and Growth Outcomes among Very Premature Infants: A Report from the New York State Perinatal Quality Collaborative. Am J Perinatol 2016;33:9-19.
35. Zhang B, Xiu W, Dai Y, Yang C. Protective effects of different doses of human milk on neonatal necrotizing enterocolitis. Medicine (Baltimore) 2020;99:e22166.
36. Webbe JWH, Duffy JMN, Afonso E, Al-Muzaffar I, Brunton G, Greenough A, *et al.* Core outcomes in neonatology: development of a core outcome set for neonatal research. Arch Dis Child Fetal Neonatal Ed 2020;105:425-31.

Supplementary Table 1: Search strategy

Database	Search terms
PubMed	(“Infant, Premature”[MeSH] OR “preterm infant” OR Infant* OR Child* OR Newborn*) AND (“Enteral Nutrition”[MeSH] OR “enteral feeding” OR feeding OR “breast milk*” OR breastfeeding OR Nutrition*) AND (“Saudi Arabia”[MeSH] OR Saudi [tiab])
Scopus	(TITLE-ABS-KEY (“preterm infant” OR “premature infant” OR infant* OR child* OR newborn*) AND TITLE-ABS-KEY (“enteral nutrition” OR “enteral feeding” OR feeding OR “breast milk” OR breastfeeding OR nutrition* OR “breast feeding”) AND TITLE-ABS-KEY (“Saudi Arabia” OR ksa)) AND PUBYEAR>2009 AND PUBYEAR<2025 AND (LIMIT-TO (DOCTYPE , “ar”) OR LIMIT-TO (DOCTYPE , “re”) OR LIMIT-TO (DOCTYPE , “cp”) OR LIMIT-TO (DOCTYPE , “ch”)) AND (LIMIT-TO (LANGUAGE , “English”) OR EXCLUDE (LANGUAGE , “Spanish”) OR EXCLUDE (LANGUAGE , “French”))
Web of Science	(TS= (“preterm infant” OR “premature infant” OR infant* OR child* OR newborn*) AND TS= (“enteral nutrition” OR “enteral feeding” OR feeding OR “breast milk” OR breastfeeding OR nutrition* OR “breast feeding”) AND TS (“Saudi Arabia” OR KSA))
Medline	TS= (“preterm infant” OR “premature infant” OR infant* OR child* OR newborn*) AND TS= (“enteral nutrition” OR “enteral feeding” OR feeding OR “breast milk” OR breastfeeding OR nutrition* OR “breast feeding”) AND TS= (“Saudi Arabia” OR KSA)
Dimensions	(“preterm infant” OR “premature infant” OR infant OR child OR newborn*) AND (“enteral nutrition” OR “enteral feeding” OR feeding OR “breast milk” OR breastfeeding OR nutrition OR “breast feeding”) AND (“Saudi Arabia” OR KSA)