



Effects of breastfeeding in postoperative complication in pediatric population: a systematic review

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Introduction: Surgical complications in younger patients can lead to infections, delayed healing, prolonged hospital stays, and other negative outcomes, significantly affecting their recovery. This study explores the potential impact of breastfeeding on mitigating these complications, aiming to enhance our understanding of postoperative care for paediatric and adolescent patients.

Methodology: The authors conducted a systematic search on databases such as PubMed, Scopus, Web of Science, and EMBASE, using relevant MESH keywords, adhering to the “Preferred Reporting Items for Systematic Reviews and Meta-analysis” methodology. Quality assessments were performed, and studies scoring above 70% were included for standardized data incorporation. Data extraction followed Cochrane Consumers and Communication Review group’s guidelines. Bias and ethical criteria were considered and provided valuable evidence to answer the research question.

Results: Among 402 initially reviewed articles, six met inclusion criteria: 3 observational cohort studies, 2 systematic reviews, and 1 randomized controlled trial. The selected literature consistently demonstrates a significant reduction in postoperative infection rates and improved outcomes. Breastfeeding shortened postoperative hospital stays, accelerated recovery, and enhanced nutritional status, potentially reducing healthcare resource utilization and patient financial burden. Lower mortality and morbidity rates were also observed.

Conclusion: This systematic review provides compelling evidence of breastfeeding’s positive impact on surgical outcomes in the paediatric population. While the authors’ findings support the benefits of breastfeeding in this age group, further large-scale, multicenter research is needed to provide stronger evidence for guiding clinical practices.

Keywords: breastfeeding, infant, postoperative complications, surgery, surgical outcomes

Introduction

Paediatric and adolescent surgeries, though increasingly advanced, continue to present concerns regarding postoperative complications. These complications, ranging from infections to delayed healing, not only affect the patients’ immediate recovery but also have long-term implications. Amidst this backdrop, a notable area of interest emerges- the potential impact of breastfeeding in reducing postoperative complications in young patients. This systematic review aims to thoroughly investigate

HIGHLIGHTS

- This systematic review highlights the potential benefits of breastfeeding in improving surgical outcomes for paediatric and adolescent patients.
- The included studies consistently showed reduced infection rates, shorter hospital stays, faster recovery, and enhanced nutritional status.
- However, further large-scale, multicenter research is necessary to strengthen the evidence and guide clinical practices effectively.

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the relationship between breastfeeding practices and postoperative outcomes in paediatric and adolescent populations.

The prevalence of postoperative complications among children and adolescents varies across regions due to disparities in healthcare access, surgical approaches, and economic factors. Recent studies have shown varying rates of complications between countries. For instance, a study in Tehran, Iran, noted that infants who received ventriculo-peritoneal shunts and were breastfed for the first six months of life exhibited better immunity and recovery compared to formula-fed infants^[1].

In contrast to the compelling role of breastfeeding in paediatric surgical recovery, there is a growing concern surrounding the care of medically complex children. A systematic review by Hookway *et al.*^[2] revealed that medically complex infants and children often face challenges in achieving optimal infant and young child feeding due to acute or chronic illnesses, disabilities, or congenital

anomalies. These challenges are exacerbated by a lack of specialist breastfeeding support, both from healthcare staff and specialized equipment.

Several studies have begun to elucidate the challenges faced by medically complex infants. For instance, Coentro *et al.*^[3] emphasized the clinical significance of factors like low intra-oral pressure, large tongue, and less effective suckling in infants with Down syndrome. Similarly, Torowicz *et al.*^[4] demonstrated how the high-stress environment of congenital heart defect patients complicates the establishment of a milk supply. Rivera *et al.*^[5] highlighted the role of the clinical environment, medical staff knowledge, and hospital routines in shaping breastfeeding experiences for infants with spina bifida.

Considering the multifaceted nature of breastfeeding and postoperative recovery, this research aims to assess the effects of breastfeeding on postoperative complication rates in paediatric and adolescent patients. We aim to fill a significant gap in the current understanding of how breastfeeding practices influence medical outcomes in this specific population. By addressing this research question, we intend to offer insights and interventions that resonate with healthcare practitioners, policymakers, and families alike.

Methodology

Research aim and search strategy

The studies for systematic review were adapted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) as shown in the flow diagram in Figure 1 and was registered on PROSPERO. The literature search was carried out according to a primary protocol and following criteria was followed to screen the studies-

- P (Population): Infants and adolescents (<24 years).
- I (Intervention): Any surgical procedure done.
- C (Comparison): Postoperative period of Breastfed versus non-breastfed population.
- O (Outcomes): Effects of breastfeeding on postoperative recovery period.

Search equations were carefully designed including relevant MESH terms and thorough research was done on four different databases—PubMed, SCOPUS, EMBASE and Web of Science (Table 1). Articles from the search results were uploaded in the Rayyan and a thorough duplicate search was performed. All the duplicate articles having more than 80% similarity were deleted after careful data evaluation.

Selection criteria

After detailed discussion with the authors, inclusion and exclusion criteria were established for data extraction (Table 2). Inclusion criteria include Studies focused on patients less than or equal 24 years age, Original Studies, Observational Studies, Systematic Review and Meta-Analysis relevant to the research question. Exclusion criteria include Editorials, commentary and short communications. Articles that are not published in English and articles that were not relevant to the research question were also excluded.

Data extraction and management

A standard template based on the Cochrane Consumers and Communication Review group's extraction template was followed for extraction of data from the articles for quality assessment and evidence synthesis. The information extracted in the data list included- authors, database, journal, date of publication, type of article, DOI, original title, full article abstract, the applied methodology, important variables of results. Retrieved records were screened for abstract, title or both and the full text of the potentially relevant articles were investigated, mapped and classified as included and excluded studies. Four authors extracted the relevant data and any discrepancies were discussed and resolved whenever needed.

Analysis and synthesis of data

The studies reported in the study were summarized in a narrative fashion. The information was classified into role of breastfeeding compared to other feeding techniques, postoperative infection rates, postoperative complications, length of hospital stay, mortality and morbidity rates, financial strain and usage of healthcare resource utilization.

Quality assessment

Different guidelines were used for the quality assessment according to the type of study. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guidelines for reporting observational studies to assess the quality of observational studies. PRISMA checklist was used to qualify systematic reviews and meta-analyses while ENTREQ guideline was followed for narrative reviews. For RCTs and Case studies, modified JADAD and CARE were followed for assessment, respectively. Ethical criteria and bias were evaluated and all included studies provided important information to answer the research question.

Evaluation of the studies

Following the abstract screening, full-text screening was carried out on an excel spreadsheet which included basic data of the study (title, author, year of publication, link to full-text) as well as the score allotted utilizing eligibility criteria. Only studies meeting at least 70% of checklist requirements were included in the study.

Results

Search strategy resulted total 402 articles among which 182 from PubMed, 163 from EMBASE, 48 from Web of Science and 9 from Scopus. All articles were imported to Rayyan and after careful evaluation for duplicate removal 367 remained. Primary screening of the title and abstract with inclusion and exclusion criteria yielded 68 articles sorted for eligibility assessment with full-text screening. Four authors carried out the title and abstract screening, followed by a full-text screening of the selected articles that were reviewed in accordance with the following eligibility criteria: Strengthening the Reporting of Observational Studies in Epidemiology for observational studies, PRISMA for review articles, ENTREQ for narrative studies, modified JADAD for RCTs and CARE for case studies and case series. This systematic review finally includes 6 studies among which 3 were

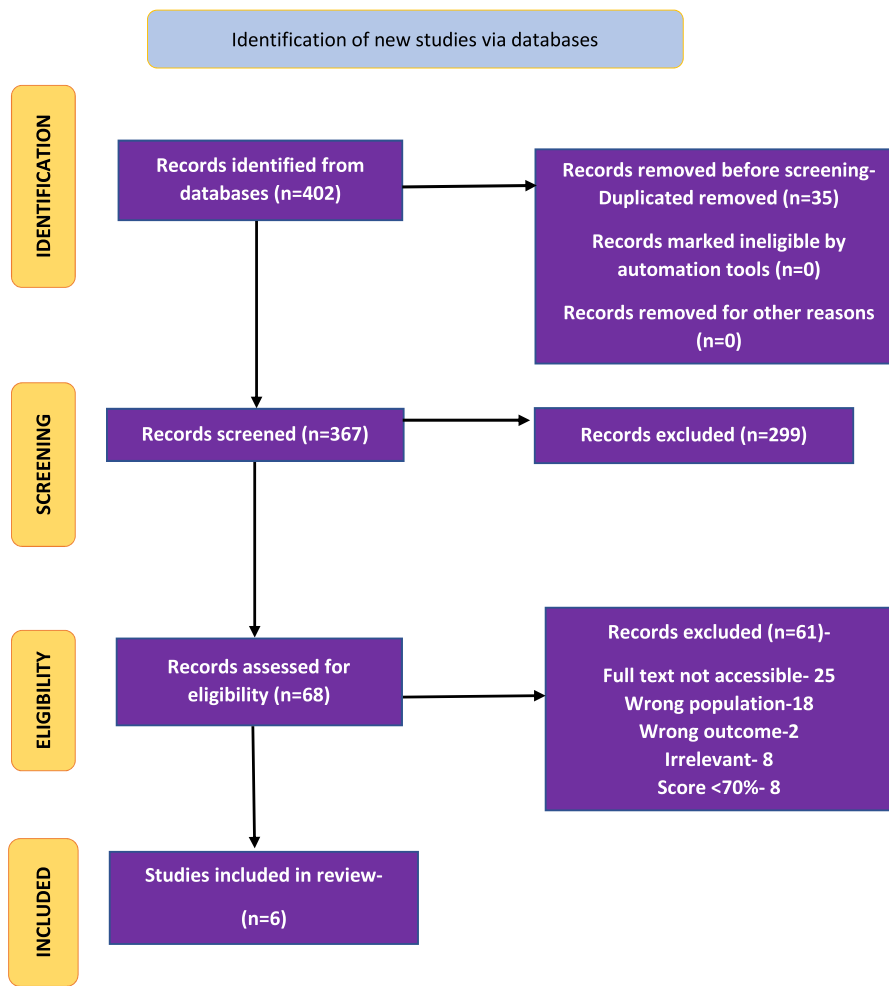


Figure 1. Schematic representation of study selection.

observational cohort studies, 2 were systematic review and 1 was randomized controlled trial (RCT). (Table 3).

Nejat and colleagues conducted a study on 127 infants with hydrocephalus who underwent VP shunt surgery within the first 6 months of life and compared the effects of breastfeeding versus formula feeding on postoperative outcome. They looked at different feeding methods: exclusively breastfed (EBF), a combination of breast milk and formula (CFBF), and exclusively formula-fed (EFF). The results showed that infants who were EBF (8.5%) had a lower risk of shunt infection compared to CFBF group (16.5%) and EFF group (26%), respectively. There was a clear trend - the more breast milk an infant received, the lower their risk of infection. The study concluded that breastfeeding, especially

exclusive breastfeeding for the first 6 months of life, may reduce the risk of shunt infections in these infants, highlighting the potential protective role of breastfeeding in preventing complications^[1].

Sahu et al included 50 infants of less than 6 months with congenital cardiac defects who had undergone open-heart surgery in a RCT and divided them into two groups based on the feed they received. Expressed breast milk (EBM) was given to the control group and EBM fortified with human milk fortifier was given to the intervention group. It was found that duration of mechanical ventilation, length of ICU stay (decreased by 2.2 days), length of hospital stay (decreased by 2.4 days), infection and mortality rate were lower in the intervention group in

Table 1
Detailed search strategy for PubMed, SCOPUS, EMBASE, and WOS

Database	Equation	Records identified (n)	Filters
PubMed	((Breastfeed*[tw] OR Breastfed[tw]) OR ("Breast Feeding"[Mesh])) AND ("Postoperative Complications"[Mesh])	182	—
Scopus	(ALL ("Breast Feeding" [mesh]) AND ALL (("Postoperative Complications" [mesh])))	9	—
Web of science	breastfeeding (All Fields) and postoperative complications (All Fields)	48	—
EMBASE	('breast feeding'/exp OR 'breast feeding' OR 'breast feeding beneficial effects') AND 'postoperative complication'	163	—

	Inclusion	Exclusion
Population	Infants and adolescents (< 24 years)	A. Animal studies B. Studies not published in English C. Not relevant to study E. Low screening score F. Non-blinding study
Intervention	Any surgical procedure done	
Comparators	Postoperative period of Breastfed vs. non-breastfed population	
Study designs	Original studies, observational studies, systematic review, and meta-analysis, case series, case reports	Editorials, short communications, commentary

comparison to the control group. So early enteral/oral feeding including enriched breast milk feed was effective and beneficial to such infants^[9].

Davis and colleagues studied the role of human milk on infants with congenital heart disease (CHD) who are at increased for necrotizing enterocolitis, chylothorax, feeding difficulties and growth failure. It was evidenced that infants receiving exclusive human milk were at lower risk for necrotizing enterocolitis and had improved weight gain. Additionally, infants with chylothorax who received skimmed human milk have higher weight-for-age scores than formula-fed infants. Human milk was recommended as the ideal source of nutrition for infants with CHD and should be encouraged by the care team^[10].

The impact of breastfeeding and bottle-feeding on surgical wound dehiscence after cleft lip repair in infants is explored in one study where they found that while alternative feeding methods like spoon-feeding were recommended to avoid tension on the surgical wound, these methods often led to infant distress, crying, and weight loss. This suggests that alternative feeding methods may not be optimal for wound healing. However, there is limited strong evidence available, and more research is needed to determine the best feeding practices for infants after cleft lip repair^[6].

A longitudinal observational study focused on infants with meconium ileus-associated cystic fibrosis (MI-CF), breastfeeding was found to have a protective effect. The study examined various factors affecting the 12-month clinical outcomes of MI-CF infants and identified that breastfeeding was associated with a reduced risk of adverse outcomes. Specifically, infants who were not breastfed were nearly three times more likely to experience negative outcomes compared to those who were breastfed. This finding suggests that early breastfeeding may have a beneficial impact on the health and outcomes of MI-CF infants, emphasizing the importance of breastfeeding support in this population^[7].

A study on giant omphalocele treatment, the authors explored that breastfeeding had a significant impact. In the tanning group, where babies were immediately and exclusively breastfed, there were fewer complications related to feeding and a shorter duration for achieving oral empowerment. This suggests that breastfeeding can play a crucial role in the management of giant omphalocele, reducing feeding-related issues and potentially improving overall outcomes for these infants^[8].

References	Type of study	Age	Sex	Country	Included participants
Matsunaka ^[6]	Systematic review	Not mentioned	M/F	Australia	Participants undergone cleft lip repair
Nejat et al. ^[11]	Propensity cohort analysis	4–170 days	M/F	Tehran, Iran	Infants with hydrocephalus who underwent VP shunt surgery within the first 6 mo of life
Padoan et al. ^[7]	Multicenter, retrospective, longitudinal observational study	Not mentioned	M/F (39 males and 46% of the infants are males)	Italy	Cystic Fibrosis infants born between 2009 and 2015 who presented with neonatal intestinal obstruction and were diagnosed with CF before 30 June 2016.
Binet et al. ^[8]	Multicenter retrospective cohort study	Neonates	M/F	France	Neonates with giant omphalocele who met specific inclusion criteria based on the size of the defect and the impossibility of immediate closure
Sahu et al. ^[9]	Prospective randomized control study	less than 6 mo	M/F	INDIA	Age <6 months, availability of mother's milk, elective surgeries
Davis ^[10]	Systematic review	Infants	M/F	USA	Not mentioned

F, female; M, male.

Discussion

Various surgeries on paediatric and adolescent populations have significant effect on these vulnerable populations due to their younger age. While multiple effective methods have been adapted to secure and improve surgical outcomes in this age group, one of the most important natural factors that could have an important influence on the surgical outcomes of the focused age group is effects of breastfeeding.

Infants with hydrocephalus undergoing VP shunt surgery

Although multiple feeding methods have been practiced for infants, breastfeeding have been proved to have a superior effect on the health of the infants in the recent studies. In terms of exclusively breastfed or supplemental feeds, several studies provided insights into the benefits of breastfeeding. One of the major complications of the surgeries in this population is the rate of infection that have grievous effects in the surgical outcome and future prognosis. In a cohort study conducted by Nejat *et al.*^[11], focusing on infants with hydrocephalus who underwent VP shunt procedures within their first six months of life, a significant association between breastfeeding practices and the incidence of shunt infections was observed. The study enrolled 127 infants, and their breastfeeding methods were categorized as exclusively breastfed (EBF), a combination of breast milk and formula feedings (CFBF), or exclusively formula-fed (EFF). Over a 6 month follow-up period, 16 patients experienced shunt infections, occurring at various intervals after shunt surgery. The analysis revealed a risk of shunt infection that was lower in the EBF group (8.5%), as compared to the CFBF (16.5%) and EFF (26.0%) groups. These findings highlight the protective effect of breastfeeding, particularly exclusive breastfeeding, in reducing the incidence of shunt infections during the first six months of an infant's life.

Length of hospital stay (congenital cardiac defects)

Concerning the length of hospital or ICU stay as a measure of postoperative recovery, Sahu *et al.*^[9] investigated the effects of early enteral nutrition therapy, which included enriched breast milk feed, on postoperative outcomes on infants with congenital cardiac defects. The results demonstrated that infants in the intervention group, who received enriched breast milk, experienced a shorter duration of mechanical ventilation and reduced lengths of ICU stay. Moreover, energy intake in the intervention group was notably higher (127.2 ± 56.1 kcal vs. 87.1 ± 38.3 kcal) on the 10th postoperative day^[9]. These statistics suggest that the combination of enteral feeding, particularly when enriched with EBM, has the potential to positively affect postoperative recovery in infants following cardiac surgery that can contribute to potentially minimizing healthcare resource utilization and financial burden of the patients. Additionally, lower infection and mortality rates were observed on the infants that have undergone open-heart surgery under six months of age^[9].

Infants with meconium ileum and cystic fibrosis

A study done by the Padoan *et al.*^[7] aimed to explore the clinical characteristics and risk factors associated with poor outcomes in infants with meconium ileus and cystic fibrosis (MI-CF). The author found that not being breastfed was associated with an increased probability of negative outcomes (odds ratio = 2.921)

which suggested that breastfeeding may help reduce the risk of chronic *Pseudomonas aeruginosa* (PA) respiratory infection in MI-CF infants. However, it is important to note that the statistical significance of this finding was borderline ($P=0.0610$), indicating the need for further research to confirm these results.

Infants with congenital heart disease

Similarly, a study by Davis *et al.*^[10] on infants with congenital heart disease highlighted that exclusive human milk feeding reduced the risk of necrotizing enterocolitis and promoted better weight gain. This emphasises the potential benefits of breastfeeding in enhancing surgical outcomes for infants with congenital heart disease.

Initiation of postoperative feeding (newborns with giant omphalocele)

The initiation of postoperative feeding in newborns is critical to their recovery. In a retrospective study done by Binet *et al.*^[8], 147 patients with giant omphalocele were included, comparing surgical management and tanning in terms of morbidity and mortality. The average duration for oral empowerment was acquired at 179 days in the surgical group leading to longer hospital stay and higher morbidity. In the tanning group where the patients were immediately and exclusively breastfed, the length of hospital stay is significantly shorter and has lower morbidity. Early breastfeeding supports the preservation of orality and enables the infant to become autonomous for oral feeding from birth. These benefits contribute to a faster demedicalization of the child and improve the overall care and well-being of the infant.

Limitations and conclusion

The effect of breastfeeding on the surgical outcomes on the paediatric is a topic that needs much further exploration and attention. Although, this systematic review has attempted to methodically include evidence from the available literature, it is not free from limitations. Firstly, the number of included studies are few for which drawing any statistically significant conclusion would be difficult. Secondly, studies in languages other than English might have important relevant data, which could not be included in this study due to the inclusion criteria. Another important limitation is the risk of bias in quality assessment of the included studies.

While breastfeeding have proven to have outstanding health benefits to the infants, its role in the surgical outcomes is an area that have been thorough explored in this study. Various effects of breastfeeding on surgical outcomes including postoperative complications, infection rates, duration of hospital and ICU stay, morbidity and mortality rates have proven to have notable positive impact on the paediatric population. Further studies are warranted to explore the role of breastfeeding in this regard to generate stronger clinical and statistical evidence.

Ethical approval

Ethics approval was not required for this systematic review.

Consent

Informed consent was not required for this systematic review.

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Author contribution

B.G.: conceptualization, data curation, formal analysis, methodology, original draft, review and editing, supervision and validation, project administration, visualization. S.S.: original draft. B.S.N.: original draft. A.D.: original draft. A.P.: original draft. P.S.: original draft.

Conflicts of interest disclosure

The authors declare no conflicts of interest.

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Data availability statement

No data available.

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