Research Article

A Survey-based Exploratory Study of Indian Pediatricians' Perspectives on Constituents of Infant Formula on Infant Gut Health

Ajazur Rahman[1], Alekha Pradhan[2], Punit Srivastava[3*], Ansar Murtuza Hussain[4], Indranil Halder[5], K. Ravikumar[6], Krishnan Ramanathan[7], P. Senthil Kumar[8], Ranjit Bhagat[9] and Ritesh Kumar Singh[10]

[1]*Department of Paediatrics and Neonatology, Dr. Abdul Rahman Memorial Hospital, Vizianagaram, Andhra Pradesh, India*
[2]*Department of Paediatrics and Neonatology, Subdivisional Hospital, Chatrapur, Odisha, India*
[3]*Department of Medical Affairs, Mediception Science Pvt. Ltd., Gurugram, Haryana, India*
[4]*Department of Paediatrics and Neonatology, Vijay Mary Hospital, Hyderabad, Telangana, India*
[5]*Department of Paediatrics and Neonatology, The Lung Care Clinic, Mogra, West Bengal, India*
[6]*Department of Paediatrics and Neonatology, Pugazhini Hospital, Trichy, Tamil Nadu, India*
[7]*Department of Paediatrics and Neonatology, Dr. Ramanathan Clinic, Trichy, Tamil Nadu, India*
[8]*Department of Paediatrics and Neonatology, Women and Child Clinic, Coimbatore, Tamil Nadu, India*
[9]*Department of Paediatrics and Neonatology, Mothercare Centre, Siliguri, West Bengal, India*
[10]*Department of Paediatrics and Neonatology, HLG Memorial Hospital, Asansol, West Bengal, India*

#ÏÒÒÅÓÐÏÎÄÉÎÇ ÁÕÔÈÏÒẓ
0ÕÎÉÔ 3ÒÉÖÁÓÔÁÖÁȟ
$ÅÐÁÒÔÍÅÎÔ ÏÆ -ÅÄÉÃÁÌ !ÆÆÁÉÒÓȟ
-ÅÄÉÃÅÐÔÉÏÎ 3ÃÉÅÎÃÅ 0ÖÔȢ ,ÔÄȢȟ
'ÕÒÕÇÒÁÍȟ (ÁÒÙÁÎÁȟ)ÎÄÉÁ
E-mail: punit@mediception.com

Received: 07-Sep-2026,
Manuscript No. AMHSR-26-194500;
Editor assigned: 10-Sep-2026,
PreQC No. AMHSR-26-194500 (PQ);
Reviewed: 24-Sep-2026,
QC No. AMHSR-26-194500;
Revised: 06-Oct-2026,
Manuscript No. AMHSR-26-194500 (R);
Published: 13-Oct-2026,
DOI: 10.54608.annalsmedical.2026.194

Abstract

Background: Functional Gastrointestinal Discomforts (FGIDs), including colic, regurgitation, constipation, and altered stool patterns are common concerns during early infancy and a frequent reason for parental consultations. While multiple Infant Formula (IF) brands are available in the market, robust comparative evidence of important ingredients of IF is lacking for clinical guidance in the absence of a mother's breast milk. **Aim:** To understand the knowledge and practices of HCPs pertaining to the role of IF containing specified microbiome-modulating ingredients and formulations in improving gut microbiome, gut health, and in the management of gastrointestinal disorders. **Methods:** This primary survey-based exploratory study was conducted using a structured questionnaire with pediatric HCPs (n=9), including five pediatricians and four neonatologists, managing over 25 infants (0-6 months) per month. Respondents were assessed based on their observations related to infant gastrointestinal symptoms, health and functional benefits of ingredients of IF and any role of formula switching. **Results:** This HCP survey cited infantile colic, bloating, excessive crying, and sleep disturbances as primary reasons for the parents to sought medical advice. The respondents (9/9) mentioned the supportive role of a stable microbiome in gut comfort, and in improving nutrient absorption. The HCPs perceived the significance of synbiotics (probiotic + prebiotic) (9/9) and GOS/FOS (7/9) as important components of gut health. HCPs also suggested that formulas containing microbiome-modulating components (*L. reuteri* + GOS/FOS) may help in improving overall digestive tolerance (8/9), and in reducing colic (8/9), constipation (7/9), diarrhea (4/9), regurgitation (6/9), and crying and irritability (9/9).

How to cite this article: Rahman A, et al. A Survey-based Exploratory Study of Indian Pediatricians' Perspectives on Constituents of Infant Formula on Infant Gut Health. Ann Med Health Sci Res. 2026;16:1-9

The use of targeted synbiotic blends, structured fats and/or whey-predominant protein profiles to facilitate digestion and improve stool consistency was also suggested by HCPs. **Conclusion:** HCPs ranked synbiotics, prebiotics, and probiotics ahead of structured beta-palmitate fats for improving gut microbiota, digestive tolerance, FGIDs prevention and management and immune health in infants.

Keywords: Breastfeeding; Infant formulas; Infant gut microbiome; Synbiotics; *L. reuteri*; GOS/FOS; Prebiotics; Probiotics; Beta-palmitate; Whey-predominant formulas

Abbreviations: DSM: Deutsche Sammlung von Mikroorganismen; FOS: Fructooligosaccharides; FGIDs: Functional Gastrointestinal Discomforts; GI: Gastrointestinal; GOS: Galactooligosaccharides; HCPs: Healthcare Professionals; HIV: Human Immunodeficiency Virus; HTLV: Human T-Lymphotropic Virus; IF: Infant Formula; ICMJE: International Committee of Medical Journal Editors; *L. reuteri*: *Limosilactobacillus reuteri*; lcFOS: long-chain Fructooligosaccharides; MS Office: Microsoft Office; NFHS: National Family Health Survey Five; QoL: Quality of Life; RCTs: Randomized Controlled Trials; scGOS: short-chain Galactooligosaccharides; SN: Stereospecific Numbering; sIgA: secretory Immunoglobulin A

Introduction

Breast milk is universally considered as a complete food and best source of nutrition for infants [1]. The World Health Organization (WHO) recommends to initiate breastfeeding within one hour of the birth and exclusive breastfeeding for the first six months of life to achieve optimal health, growth, and development [2]. Despite universal advocacy for breastfeeding, as per the Global Breastfeeding Scorecard 2024 less than half (48%) of infants are exclusively breastfed till 6 months of age [3]. In India, National Family Health Survey Five (NFHS-5) 2019-21 reports exclusive breastfeeding in only 64% of children and separate studies from Rajkot, southern India, and Tamil Nadu reports exclusive breastfeeding in 62%, 50.7%, and 34% of infants up to 6 months of age respectively [4-7].

Human breastmilk is a rich source of prebiotics, probiotics, human milk oligosaccharides, and antimicrobial factors that inhibits pathogenic bacteria and promotes establishment of healthy gut bacteria such as *Lactobacilli* and *Bifidobacteria*, hence playing a crucial role in maintaining good gut health, nutrient absorption, and immune function of an infant [8,9]. Breast milk is a rich source of proteins with whey being the predominant protein component than casein [9]. Whey components including lactoferrin, α-lactalbumin, serum albumin, immunoglobulins, and growth factors offer vital support for nutrient delivery and immune system [9,10]. Lactose is an easily digestible predominant source of carbohydrate and energy, which acts as a natural prebiotic, facilitates micronutrient absorption and promotes the growth of *Bifidobacteria* within the infant's gut [9,11].

In certain situations, exclusive breastfeeding is neither feasible nor inadequate. Breastfeeding is contraindicated in infant galactosemia, HIV, or HTLV positive mothers, or in those with Ebola virus disease or use of illicit drugs [12]. Women with high-risk pregnancies associated with hypertension, obesity, and diabetes initiate breastfeeding less often and discontinue early [13]. With the changing nature of women's employment, social norms, and high incomes, increasing use of formula feed is seen in urban communities of developing and industrialized countries, citing the reason for insufficient milk production [14-16]. With existing barriers to exclusive breastfeeding coupled with inadequate or lack of breastmilk, formula feeds can be considered as an option for infant feeding, even though the benefits of breastfeeding remain unequivocal and exclusive breastfeeding for the first six months of life is the recommended standard by WHO [17].

Infant formulations are enriched with milk proteins, lactose, fats, and micronutrients adjusted for age-specific nutritional needs of babies [9,17]. Many formulations are also supplemented with bioactive compounds such as probiotics, prebiotics, and human milk oligosaccharides to support optimal growth and overall health [18].

A healthy gut microbiome is critical for strong digestive and immune health and overall well-being of an infant [19]. Nearly 50% of infants until the age of 6 months are affected by at least one of the Functional Gastrointestinal Disorders (FGIDs), including regurgitation, colic, functional constipation, functional diarrhea, cyclic vomiting, infant dyschezia, and infant rumination syndrome, which are also common causes of parental distress [20].

Efforts have been made to encourage a healthy gut microbiome profile in formula-fed infants similar to breastfed infants by optimizing the whey-to-casein ratio, by adding prebiotics, probiotics, or synbiotics (synergistic combinations of both) to the formulation, which support gut health and provide health benefits influenced through the gut microbiome [21-23]. The objective is to ensure that in the absence of breastmilk, the formula should support the

development of a balanced gut microbiome profile both in its composition and function [22].

HCPs play a critical role by providing reassurance to continue breastfeeding (up to 2 years or beyond), sharing advice on proper feeding behaviors, and appropriate nutritional alternatives that could be considered as an option for breast milk nutrition especially in cases of lack/ inadequate breastfeeding for supporting gut discomfort, avoid inappropriate use of medication when possible, and have a positive impact on the growth and development of the infant [20,24]. Physicians practice may be influenced by the information provided by different formula manufacturers, [25] but the large number of available brands and limited head to head scientific evidence comparing their ingredients can create uncertainty and lead to variable knowledge and clinical practices.

Limited literature evidence is available regarding the comparative effectiveness and safety of the IF ingredients and specifically related to the available IF in India. To the best of our knowledge, there is current lack of studies exploring the formula-prescribing behaviour of the Indian HCPs. This clinical practice exploratory survey was done to understand the current knowledge, perception, and clinical practice of Indian pediatricians based on their observational insights, pertaining to various ingredients added in the infant formulations and their effects on infant's digestive health and FGIDs.

Materials and Methods

Survey objective

This survey was designed to understand the knowledge, perception, beliefs, and confidence among Indian pediatric HCPs while recommending IF to infants in the age group of 0 to 6 months through a structured questionnaire.

Survey participants and design

The survey was conducted with Indian clinicians, including both pediatricians and neonatologists, who were attending to and managing infants in the age group 0-6 months and were fed IF either due to medical breastfeeding contraindication or when the mother was not available for breastfeeding due to her work commitments or any underlying health conditions. The clinicians were approached from all geographic locations, and those who were willing to participate in the study and share their clinical practice opinion were shortlisted. The HCPs were selected based on their clinical practice including number of years of experience and patient volume. The participation of the HCPs was voluntary.

Data collection and analysis

A structured questionnaire was developed through a comprehensive review of current clinical guidelines and available peer-reviewed literature on nutritional practices and growth parameters. The questionnaire comprised of questions with yes/no choices, scores rated on a Likert scale from 1 to 5, categorized from never to very often, not important to extremely important, strongly disagree to strongly agree, and some questions also had subjective choices. As the survey intend to include a small group of HCPs, pilot testing was not done. The survey was conducted through telephonic interviews, and the responses were verbatim to capture and document accurate, rapid, and detailed nuances of the data. The survey consisted of 30 questions and took approximately 10–15 minutes to complete. Physicians' opinions were based on their clinical practice patterns and in-clinic observations. Survey data were analyzed using MS Office 365 Excel statistical tools. Descriptive statistics were applied to analyze the collected data, and the outcomes were calculated and presented as numbers (n/N) and percentages (%). The findings of this survey reflect physicians' perceptions and clinical observations rather than prospectively measured patient outcomes.

Ethical considerations

Ethical committee review was not required as it was a survey of the observation and perceptions of pediatric HCPs, and there was no participation of the patients, and no collection of any patient identifiable data.

Results

HCP demographics and clinical burden

The survey included nine pediatric HCPs, comprising 56% (5/9) general pediatricians and 44% (4/9) neonatologists. The cohort was highly experienced, with 89% (8/9) of HCPs having >10 years of clinical practice. The patient volume was substantial, with 33% (3/9) HCPs managing 26–50 infants (0–6 months) monthly and 67% (6/9) managing >50 infants.

Infantile colic, bloating, excessive crying, and sleep disturbances were perceived as the primary drivers for clinical consultations, consistent with established prevalence data in scientific papers. In formula fed infants, 67% (6/9) HCPs reported bloating, 56% (5/9) mentioned sleep disturbances, vomiting, and infantile colic and reported excessive crying or fussiness, followed by regurgitation 44% (4/9), hard stools 33% (3/9), and loose stools 22% (2/9) as the major reason for seeking medical advice by parents. Notably, 78% (7/9) of HCPs reported that parental anxiety significantly increased consultation duration.

For the assessment of GI comfort, 78% (7/9) HCPs mentioned improved stool consistency and reduced crying/ fussiness, 67% (6/9) mentioned reduced gas/distension, improved sleep, and better growth parameters while reduced regurgitation and caregiver satisfaction were mentioned by 56% (5/9) HCPs as important clinical parameters.

Ingredient effectiveness to support microbiome modulation

There was a unanimous consensus of 100% (9/9) HCPs that a balanced microbiome is essential for gut comfort, as 89% (8/9) strongly agreed and 11% (1/9) agreed regarding its role

in nutrient absorption. 67% (6/9) HCPs considered adding both probiotics and prebiotics in IF as important or very important while 33% (3/9) HCPs rated it as somewhat important to support digestive health and immune system development.

Regarding the impact of ingredients of IF on modulating gut microbiome, improving digestion and Gastrointestinal (GI) comfort, 100% (9/9) HCPs perceived the presence of synbiotics in IF as either very important: 56% (5/9) or important: 44% (4/9), followed by the fiber blend (inulin and FOS), for which 33% (3/9) participants perceived their role as very important, 56% (5/9) rated it as important and 11% (1/9) as somewhat important while the presence of a single prebiotic (only GOS or FOS) was perceived as very important by 33% (3/9), important by 44% (4/9), and somewhat important by 22% (2/9) participants respectively. 100% (9/9) respondents perceived that use of synbiotics and structured fats similarly relieve colic/fussiness, and this effect is much better with synbiotics compared to prebiotic blend, other than GOS/FOS blend.

Regarding the role of protein profiles in supporting digestion, 56% (5/9) HCPs perceived whey-dominant formulas, while 22% (2/9) perceived casein-dominant formulas and 22% (2/9) perceived equal casein-to-whey ratio as supporting digestion. Whey-protein in IF was also perceived as either extremely important by 78% (7/9) or moderately important by 22% (2/9) HCPs for reducing infant GI discomfort.

Regarding the stool consistency in infants, 100% (9/9) HCPs shared their observation that it is a major parental concern and synbiotics support softer stools in infants. While 56% (5/9) HCPs perceived several other ingredients as supportive, including a higher whey-to-casein ratio, 100% lactose, structured fats (SN-2 palmitate/beta-palmitate), probiotics and prebiotics (GOS/FOS), and an optimal calcium-to-phosphorus ratio of 2.

The HCPs agreed that the presence of both probiotics and prebiotics, that is, synbiotics, is a more effective strategy rather than the combination of two prebiotics Inulin and Fructo-oligosaccharides (FOS). The synbiotic blend of *L. reuteri* and GOS/FOS was perceived as highly effective, with 100% (9/9) HCPs reporting its benefits in terms of reduced crying/irritability, 89% (8/9) HCPs suggested improved colic and better overall digestive tolerance and 78% (7/8) HCPs mentioned relieved constipation with its use. 89% (8/9) HCPs mentioned that they recommend IF with synbiotics being recommended very often by 33% (3/9) or by 56% (5/9) as often as IF supplemented with synbiotics is well accepted, supports better digestion and improves GI comfort and only 11% (1/9) HCPs rarely do so. 89% (8/9) HCPs also perceived synbiotic formulas as well accepted (high or moderate acceptance) by majority of the parents while 11% (1/9) HCPs reported neutral acceptability of parents.

When prescribing formula, the primary therapeutic goals were gut comfort and immune support. Thereafter, digestive tolerance and high formula acceptance were the focus, followed by a reduction in crying and fussiness. 89% (8/9) HCPs believed that they change formulas sometimes for GI discomfort in infants of 0-6 months of age while 11% (1/9) reported never changing the formula. 100% (9/9) HCPs mentioned that there are perceived benefits of improvement in gut comfort in infants with GI discomfort following the formula change. 56% (5/9) HCPs perceived that improvement in gut comfort following formula change can be seen within 4–7 days or 33% (3/9) mentioned within 24–72 hours, while 11% (1/9) HCPs reported improvement within 24 hours.

Discussion

This cross-sectional survey was done to understand the factors influencing clinical decision-making among Indian pediatric HCPs when recommending IF to infants aged 0–6 months. To our knowledge, this is the first survey in India to gather HCP understanding, perceptions, and clinical practices regarding formula ingredients and their perceived effectiveness in a real-world setting.

Clinical presentation and gastrointestinal comfort

HCPs perceived infantile colic, bloating, excessive crying, and sleep disturbances as the primary reasons parents seek medical advice for non-illness-related FGIDs, followed by regurgitation, and loose stools, while vomiting and hard stools were cited less frequently.

In our survey findings, most of the HCPs defined improved GI comfort in terms of better stool consistency, reduced crying/fussiness, and gut-related pediatrician visits followed by reduced gas/distension, improved sleep, better growth parameters, reduced regurgitation/vomiting, and better parent/caregiver satisfaction.

Consistent with an international survey from eight countries including pediatricians, and other practitioners, which suggested absence of GI-discomfort symptoms, effective digestion and absorption of food as indicated by normal growth and feeling of wellbeing as the three most important indicators for infant gut health followed by strong immune function, absence of GI related infections, and stool consistency and frequency, which was also mentioned as one of the top three indicators of GI health in the Asian region [26].

HCPs in our survey also mentioned that parental anxiety related to feeding discomfort and infant crying impacts their consultation time. These impressions aligned with other studies which suggest that FGIDs and especially excessive crying can be stressful to the families, cause parental anxiety, affect the Quality of Life (QoL), and feeding patterns including breastfeeding, frequent formula changes and increased medical consultations [27].

The respondents shared that a balanced microbiome is essential to ensure gut comfort in infants and the HCPs agreed that a stable and balanced gut microbiome supports better nutrient absorption. As per the available literature evidence, gut microbiome is known to play a crucial role in

digestion of food including breastmilk, formula feed and others, protects against pathogenic organisms, and promotes immunity development [28,29]. Conversely, microbial imbalance (dysbiosis) is linked to intestinal barrier dysfunction, malabsorption, and the generation of toxic metabolites, potentially influencing behavior and stress responses through the gut-brain axis [30,31].

Understanding of infant formula ingredients and perceived clinical efficacy

Fiber blends: Unlike the robust, multi-center clinical evidence available for the scGOS/lcFOS (9:1) ratio, limited evidence base is available for use of inulin-FOS fiber blends in early infancy). Scientific literature, such as the systematic reviews by Lohner et al. and Skórka et al., suggests that while some prebiotics show promise, the quality of evidence for many functional outcomes remains "low" to "very low," making broad clinical assertions premature [31,32]. There is not enough evidence available for combined use of Inulin and FOS regarding its clinical efficacy regarding the reduction in crying time, increased sleep duration, and improved stool consistency. More clinical data is required to support the use of Inulin and FOS fibre blend in IF.

Prebiotics: The prebiotic oligosaccharides added to IF are well-tolerated and supports softer stools when compared to un-supplemented formula [23]. scGOS/lcFOS (9:1) prebiotic mixture is widely used due to its beneficial effects on infant gut microbiota as observed in various studies [32,33]. A systemic review and meta-analysis by Kadim et al., demonstrated that IF containing scGOS/lcFOS (9:1) improves GI health and immunity in healthy infants as seen with higher intestinal bifidobacteria colonization, softer stool, improved stool frequency, reduced fecal pH, higher fecal acetate and fecal D- and L-lactate levels, and improved sIgA levels [32]. Studies indicate these benefits can persist even after supplementation ceases [33]. Another study by Costalos C et al., demonstrated that infants receiving IF with GOS/FOS had significantly higher stool frequency, softer stools, and lower percentage of clostridia, although the higher percentage of bifidobacteria observed was not significant [34].

Probiotics: The clinical utility of probiotics such as *Limosilactobacillus reuteri*, strain DSM 17938 in infant nutrition is supported by various clinical trials and research studies that demonstrated its efficacy in stabilizing neonatal gut milieu and influence systemic health through the gut-organ axes.

In infant colic, *L. reuteri* DSM 17938 associates with reduction of symptoms as seen in a prospective randomized study [9]. Meta-analyses and Randomized Controlled Trials (RCTs) consistently showed that *L. reuteri* DSM 17938 significantly reduced daily crying and fussing times in infants with colic, often achieving a reduction of >50% within 14 to 21 days [35-37]. Beyond symptomatic relief, landmark research by Indrio et al., demonstrated that prophylactic administration of *L. reuteri* in the first months of life can significantly lower the incidence of regurgitation, functional constipation, and the subsequent need for medical consultations, establishing its role as a preventive intervention [38]. Another study by Indrio et al., demonstrated the efficacy of a partially hydrolysed whey infant formula supplemented with starch and *L. reuteri* in improving gastric emptying and reducing the regurgitation frequency [39].

Literature evidence suggests that *L. reuteri* can have benefits beyond localized gut health. Microbiome modulation by *L. reuteri* influences bidirectional gut-brain-organ axis which contributes to improved mood stability and reduced irritability by modulating the enteric nervous system and reducing visceral hypersensitivity [40,41].

Stable gut fermentation and reduced GI distress also correlated with improved sleep duration and hygiene [42] and plays a role in nutrient absorption and hormonal signalling and support better appetite regulation and overall wellbeing [43,44].

Synbiotic synergy: In our survey, most of the HCPs perceived that synbiotic containing *L. reuteri* and/or GOS/FOS are beneficial in reducing crying or irritability, and colic symptoms, improving overall digestive tolerance and constipation and some suggested its role in reducing diarrhea.

Recent scientific advancements have highlighted that the synbiotic association of *L. reuteri* with prebiotics GOS and FOS yield clinical benefits, creating a specific metabolic environment that fosters not only digestive tolerance but also systemic physical development. An RCT by Lee et al., including 140 infants who received an IF containing a symbiotic combination of *L. reuteri*, GOS, and FOS, noted a slightly higher mean weight gain of infants compared to controls suggesting addition of synbiotics support normal growth and are safe to use [45]. Synbiotics have also shown to affect fecal milieu, immunity, and reduce the occurrence of lower respiratory tract infections [46,47].

Another study by Bonnet et al., indicate that infants receiving formula supplemented with *Limosilactobacillus reuteri* DSM 17938 and GOS demonstrate positive growth trajectories, including enhanced bone mineralization and muscle mass development by modulating the composition and function of the microbiota [48]. Longitudinal outcomes from this double blind RCT by Bonnet et al., suggest that optimized nutrient absorption and reduced inflammatory markers associated with this synbiotic pairing can ameliorate vitamin D insufficiency, and may support development of healthy bone and muscles.

As per our survey results, symbiotic containing IF seems to be well accepted by majority of the parents and caregivers. Similarly, in a double-blind controlled trial, parents of healthy infants of one-month age reported a good acceptance of the synbiotic supplemented formula by the infant [47].

Structured fats (SN-2 Palmitate): In human milk, over 70% of palmitic acid is esterified at the SN-2 position of the

triacylglycerol molecule, which facilitates efficient digestion [49,50].

Although the inclusion of SN-2 palmitate has shown to reduce fecal soap levels and improve stool consistency, due to lack of scientific literature, SN-2 palmitate alone cannot be equated to a comprehensive nutritional solution for FGIDs. The etiology of FGIDs, including colic, bloating, and dysbiosis is multifactorial and involves gut-brain axis communication and microbial composition that structured fats do not directly address [51]. Even though SN-2 palmitate improves physical stool properties, it has not been observed to contribute to immune modulation, the bifidogenic effect offered by scGOS/lcFOS (9:1), or the reduction in gastric emptying time provided by *Limosilactobacillus reuteri*.

An observational real-world study by Vandenplas et al., in formula fed infants (n=196) of 0–4 months ago with atleast two FGIDs receiving an IF supplemented with partial whey hydrolysate, starch, prebiotics FOS and GOS, probiotic *L. reuteri* DSM 17938 and high magnesium demonstrated a decrease in FGIDs within 3 days ($p<0.0001$) followed by an improvement of QoL of infant and families after 7 days ($p=0.008$) [52]. Adequate nutritional intervention is shown to have a very beneficial impact on the functional gut problems and QoL of families and infants [52]. Therefore, the standalone presence of SN-2 palmitate may be insufficient to achieve the desired gut microbiome modulation to accomplish digestive tolerance and immune support required for the optimal management of non-illness-related gut distress in infants.

Protein profile, carbohydrates, and minerals: In our survey physicians perceived the role of whey-dominant formulas as beneficial in supporting digestion and some also mentioned their role in reducing GI discomfort and supporting softer stools in infants. An optimal ratio of whey and casein can help to overcome delayed gastric emptying in infants. Literature suggests that whey-dominant IF having lower protein levels closely match the breast milk composition, promotes healthy and adequate growth in infants [53].

Literature supports the use of whey-dominant formulas, as a higher whey-to-casein ratio (60:40 to 70:30) promotes the formation of softer gastric curds, significantly accelerating gastric emptying, and reducing the prevalence of hard stools compared to casein-predominant alternatives [24,54]. Studies have demonstrated a higher bifidogenic potential and microbiota profile similar to breast-fed infants with a whey protein formula with low protein and phosphate compared to control [55].

The optimization of protein and carbohydrate profiles is important for replicating the physiological benefits of human milk and mitigating FGIDs. Use of 100% lactose as the primary carbohydrate synergistically enhances digestive tolerance beyond its role as an energy source, as lactose exerts a crucial osmotic effect that increases stool water content and serves as a substrate for beneficial commensal bacteria, thereby acidifying the colonic environment and alleviating symptoms of functional constipation [43].

The benefits of micronutrients are dependent on a precise mineral balance, specifically an optimal calcium-to-phosphorus ratio of approximately 2:1.24 A deviation toward the lower 1.2:1 ratio, found in unmodified bovine milk 24 can trigger the formation of insoluble calcium-phosphorus soaps, leading to increased stool hardness and rectal stimulation requirements, whereas a 2:1 ratio ensures superior mineral bioavailability and stool consistency.

An overall perceived significance and clinical benefits of IF ingredients have been suggested in Table 1.

Table 1: Perceived significance and clinical benefits of infant formula ingredients.

Ingredient	Perceived significance*	Perceived clinical benefit
Synbiotics (*L. reuteri* + GOS/FOS)	Highest	Colic reduction, softer stools, and immunity
Whey-predominant protein	Highest	Easy to digest and reduced GI discomfort
Structured fats (Beta-palmitate)	Moderate	Fat absorption and stool softening
Prebiotic fiber blends	Moderate/Low	General gut health (limited by evidence specificity)
100% Lactose	Low	Minimal perceived impact on GI comfort/stools.

Note: *The terms highest, moderate, and lowest reflect the number of HCPs who perceived a beneficial effect of the infant formula ingredient as follows: Highest: 7/9 to 9/9, Moderate: 4/9–5/9, Low: <3/9

Based on the survey results and the integration of the current scientific literature, the HCPs have proposed the following suggestions for clinical practice:

- **Adopt a multi-component approach for FGIDs:** The management of infantile colic, bloating, and constipation cannot rely on a single ingredient. Although SN-2 palmitate improves stool consistency, it must be evaluated with scientifically validated prebiotics (such as scGOS/lcFOS 9:1), probiotics (e.g., *L. reuteri*), or synbiotics to address the multifactorial nature of FGIDs, including gut microbiome modulation and immune regulation.
- **Prioritize evidence-based ingredient ratios:** Clinicians should distinguish between ingredients with robust long-term clinical data and those with preliminary findings. The scGOS/lcFOS (9:1) ratio and specific probiotic strains, such as *L. reuteri* DSM 17938, have been

scientifically proven to promote a bifidogenic effect and reduce gastric distress.

- **Address parental anxiety through nutritional efficacy:** Formula switching is frequently driven by parental concern rather than clinical pathology. Utilizing a multi-component formula may help in faster symptom relief and improve family QoL and avoid unnecessary and frequent formula changes that can further disrupt the infant's digestive milieu.

Limitations and research gap

Inclusion of specific pediatric HCPs from India and the small sample size of the respondents potentially limits the generalizability of our results. The data collected was based on self-reporting which relies on participants' recall and subjective responses and can introduce recall or subjective bias. The cross-sectional approach used offers a single-point snapshot which prevents the ability to establish causal relationships. While clinical experience with a particular ingredient suggests advantages, the current evidence does not provide direct patient level data and direct comparison between various commercial formulas, and no inferential conclusions can be drawn from this survey. Though this survey-based study provides valuable insights from HCPs on their perceived importance of formula ingredients, but to conclude real-world insight on various IF containing different ingredients, these must be evaluated in a comparative head-to-head clinical study.

Future research directions

There is a significant lack of high-powered, randomized controlled head-on comparative studies between commercial formulas containing different ingredients, such as synbiotics, specific fat components, or fiber blends. Well-structured head-to-head comparative studies are essential to translate individual scientific evidence into real-world clinical benefits. Future studies should also explore how specific ingredient combinations, rather than single components affect the infant gut health, long-term physical growth, immune support, and overall health.

Conclusion

With the increasing use of infant formulas, it is important to understand the clinical practices and perceptions of the prescribing paediatricians. In this survey, physicians perceived balanced gut microbiota, functional gut disorders, immunity, and parental reassurance as important factors that drive the use of infant formulas. Most of the HCPs perceived prebiotics (GOS/FOS), synbiotics, whey-predominant proteins and structured fats (beta-palmitate) enriched formulas as beneficial in enhancing digestive tolerance, supporting gut comfort, and improving functional GI symptoms, and overall health of an infant. However, the findings of our study are limited by its cross-sectional methodology and small sample size of respondents. Future efforts should focus on head-to-head comparative studies to validate and ensure that nutritional interventions for Indian infants are grounded in real-world clinical experience.

Consent for Publication from Authors

All authors hereby voluntarily agree to participate in this survey and understood the purpose of the survey and confirm that the information provided by me will be used only for research/scientific purposes in an aggregated and confidential manner.

Competing Interests

Dr. Punit Srivastava is an employee of Mediception Science Pvt. Ltd. Mediception is engaged in medical content writing, project conceptualization, and real-world evidence generation for healthcare professionals, pharmaceutical and nutraceutical manufacturing companies.

Funding

None.

Acknowledgments

The author meets the International Committee of Medical Journal Editors (ICMJE) criteria for authorship of this manuscript, takes responsibility for the integrity of the work, and has given final approval for the version to be published.

References

1. Smilowitz JT, Allen LH, Dallas DC. Ecologies, synergies, and biological systems shaping human milk composition—a report from "Breastmilk Ecology: Genesis of Infant Nutrition (BEGIN)" Working Group 2. Am J Clin Nutr. 2023;117:S28-S42.
2. Nutrition. Exclusively breastfeed for 6 months. World Health Organization. 2026.
3. UNICEF. Breastfeeding Scorecard 2024. 2024. Accessed August 11, 2026.
4. Chudasama RK, Amin CD, Parikh YN. Prevalence of exclusive breastfeeding and its determinants in first 6 months of life: A prospective study. Online J Health Allied Sci. 2009;8.
5. Rynjah MM, Venkatachalam J, Adhisivam B, Olickal JJ, Sundaram SP, et al. Non-exclusive breastfeeding amongst high-risk children: Factors and barriers associated with non-exclusive breastfeeding at a tertiary care hospital in Southern India. Niger Postgrad Med J. 2021;28:62.
6. Balamuruga S, Radhakrishnan S. Prevalence of exclusive breastfeeding practices among rural women in Tamil Nadu. Int J Health Allied Sci. 2012;1:64.
7. ICF. India National Family Health Survey (NFHS-5), 2019-21. 2021.
8. Okburan G, Kiziler S. Human milk oligosaccharides as prebiotics. Pediatr Neonatol. 2023;64:231-238.
9. Kariyawasam KP, Somaratne G, Dillimuni SD, Walallawita U. Comparative analysis of breastfeeding and infant formulas: Short- and long-term impacts on infant nutrition and health. Food Sci Nutr. 2025;13:e70788.

10. Li X, Zhang X, Zhang M, Liu X, Gao Z, et al. Human milk whey proteins: Constituents, influencing factors, detection methods, and comparative analysis with other sources. Food Chem X. 2025;25:102082.
11. Cheema AS, Stinson LF, Rea A. Human milk lactose, insulin, and glucose relative to infant body composition during exclusive breastfeeding. Nutrients. 2021;13:3724.
12. Davanzo R. Controversies in breastfeeding. Front Pediatr. 2018;6:278.
13. Kozhimannil KB, Jou J, Attanasio LB, Joarnt LK, McGovern P. Medically complex pregnancies and early breastfeeding behaviors: A retrospective analysis. PLoS One. 2014;9:e104820.
14. Baker P, Santos T, Neves PA, Machado P, Smith J, et al. First-food systems transformations and the ultra-processing of infant and young child diets: The determinants, dynamics and consequences of the global rise in commercial milk formula consumption. Matern Child Nutr. 2020;17:e13097.
15. Piccolo O, Kinshella MLW, Salimu S. Healthcare worker perspectives on mother's insufficient milk supply in Malawi. Int Breastfeed J. 2022;17:14.
16. Kera AM, Zewdie A, Akafu W, Kidane R, Tamirat M. Formula feeding and associated factors among mothers with infants 0–6 months old in Mettu Town, Southwest Ethiopia. Food Sci Nutr. 2023;11:4136-4145.
17. Martin CR, Ling PR, Blackburn GL. Review of infant feeding: Key features of breast milk and infant formula. Nutrients. 2016;8:279.
18. Bakshi S, Paswan VK, Yadav SP, Bhinchhar BK, Kharkwal S, et al. A comprehensive review on infant formula: Nutritional and functional constituents, recent trends in processing and its impact on infants' gut microbiota. Front Nutr. 2023;10:1194679.
19. Wong CB, Huang H, Ning Y, Xiao J. Probiotics in the new era of human milk oligosaccharides (HMOs): HMO utilization and beneficial effects of *Bifidobacterium longum*subsp. infantis M-63 on infant health. Microorganisms. 2024;12.
20. Vandenplas Y, Hauser B, Salvatore S. Functional gastrointestinal disorders in infancy: Impact on the health of the infant and family. Pediatr Gastroenterol Hepatol Nutr. 2019;22:207-216.
21. Catassi G, Aloi M, Giorgio V, Gasbarrini A, Cammarota G, et al. The role of diet and nutritional interventions for the infant gut microbiome. Nutrients. 2024;16:400.
22. Lemoine A, Tounian P, Adel-Patient K, Thomas M. Pre-, pro-, syn-, and postbiotics in infant formulas: What are the immune benefits for infants? Nutrients. 2023;15:1231.
23. Chong HY, Tan LTH, Law JWF. Exploring the potential of human milk and formula milk on infants' gut and health. Nutrients. 2022;14.
24. Kesavelu D, Sethi G, Bangale N, Anwar F, Rao S. Common gastrointestinal distress among infants: Role of optimal nutritional interventions. Clin Epidemiol Glob Health. 2018;6:5-9.
25. Wang Y, Zhang H, Chang S, Huysentruyt K, Chong SY, et al. The characteristics of formula milk marketing on health system: A qualitative study from Beijing and Jinan in China. BMC Public Health. 2024;24:3289.
26. Muhardi L, Delsing DJM, Zakharova I, Huysentruyt K, Chong SY, et al. Early-life gut health indicators and reported prevalence of infant functional constipation by healthcare professionals. Nutrients. 2023;15:298.
27. Salvatore S, Abkari A, Cai W, Catto-Smith A, Cruchet S, et al. Review shows that parental reassurance and nutritional advice help to optimise the management of functional gastrointestinal disorders in infants. Acta Paediatr. 2018;107:1512-1520.
28. Ahearn-Ford S, Berrington JE, Stewart CJ. Development of the gut microbiome in early life. Exp Physiol. 2022;107:415-421.
29. Yang I, Corwin EJ, Brennan PA, Jordan S, Murphy JR, et al. The infant microbiome: Implications for infant health and neurocognitive development. Nurs Res. 2016;65:76-88.
30. Cong X, Henderson WA, Graf J, McGrath JM. Early life experience and gut microbiome: The brain-gut-microbiota signaling system. Adv Neonatal Care. 2015;15:314-323.
31. Sandhu AH, Radhakrishnan A. Gut biome-mediated barriers to nutrient absorption: Investigating the impact of dysbiosis. Microbiol Res. 2025;16.
32. Kadim M, Darma A, Kartjito MS. Gastrointestinal health and immunity of milk formula supplemented with a prebiotic mixture of short-chain galacto-oligosaccharides and long-chain fructo-oligosaccharides (9:1) in healthy infants and toddlers: A systematic review with meta-analysis. Pediatr Gastroenterol Hepatol Nutr. 2025;28:1-18.
33. Salvini F, Riva E, Salvatici E. A specific prebiotic mixture added to starting infant formula has long-lasting bifidogenic effects. J Nutr. 2011;141:1335-1339.
34. Costalos C, Kapiki A, Apostolou M, Papathoma E. The effect of a prebiotic supplemented formula on growth and stool microbiology of term infants. Early Hum Dev. 2008;84:45-49.
35. Savino F, Cordisco L, Tarasco V. *Lactobacillus reuteri* DSM 17938 in infantile colic: A randomized, double-blind, placebo-controlled trial. Pediatrics. 2010;126:e526-e533.
36. Coccorullo P, Strisciuglio C, Martinelli M, Miele E, Greco L, et al. *Lactobacillus reuteri* DSM 17938 in infants with functional chronic constipation: A double-blind, randomized, placebo-controlled study. J Pediatr. 2010;157:598-602.
37. Gutiérrez-Castrellón P, Indrio F, Bolio-Galvis A, Jiménez-Gutiérrez C, Jimenez-Escobar I, et al. Efficacy of *Lactobacillus reuteri* DSM 17938 for infantile colic. Medicine (Baltimore). 2017;96:e9375.
38. Indrio F, di Mauro A, Riezzo G. Prophylactic use of a probiotic in the prevention of colic, regurgitation, and functional constipation: A randomized clinical trial. JAMA Pediatr. 2014;168:228-233.
39. Indrio F, Riezzo G, Giordano P. Effect of a partially hydrolysed whey infant formula supplemented with starch and *Lactobacillus reuteri* DSM 17938 on regurgitation and gastric motility. Nutrients. 2017;9:1181.
40. Mu Q, Tavella VJ, Luo XM. Role of *Lactobacillus reuteri* in human health and diseases. Front Microbiol. 2018;9:757.

41. Zhen J, Zhou Z, Zhu R, Kuang M, Huang P. Research progress on the role of *Lactobacillus reuteri* in irritable bowel syndrome: A review. Biology. 2026;15:808.
42. Lin Z, Jiang T, Chen M, Ji X, Wang Y. Gut microbiota and sleep: Interaction mechanisms and therapeutic prospects. Open Life Sci. 2024;19:20220910.
43. Zhang C, Lin G, Lu X, Yu X. Exploring the role of the gut microbiome in pediatric gastrointestinal and neurological health. Transl Pediatr. 2025;14:3449-3472.
44. Li X, Xing M, Zhang Y, Yang M. Therapeutic effect of *Lactobacillus reuteri* DSM 17938 on feeding intolerance in preterm infants. Arch Med Sci. 2023.
45. Lee LY, Bharani R, Biswas A, Lee J, Tran LA, et al. Normal growth of infants receiving an infant formula containing *Lactobacillus reuteri*, galacto-oligosaccharides, and fructo-oligosaccharide: A randomized controlled trial. Matern Health Neonatol Perinatol. 2015;1:9.
46. Szajewska H, Ruszczyński M, Szymański H, Sadowska-Krawczenko I, Piwowarczyk A, et al. Effects of infant formula supplemented with prebiotics compared with synbiotics on growth up to the age of 12 mo: A randomized controlled trial. Pediatr Res. 2017;81:752-758.
47. Piloquet H, Vrignaud B, Gillaizeau F, Capronnier O, Berding K, et al. Efficacy and safety of a synbiotic infant formula for the prevention of respiratory and gastrointestinal infections: A randomized controlled trial. Am J Clin Nutr. 2024;119:1259-1269.
48. Bonnet N, Capeding MR, Siegwald L, Garcia-Garcera M, Desgeorges T, et al. A young child formula with *Limosilactobacillus reuteri* and GOS modulates gut microbiome and enhances bone and muscle development: A randomized trial. Nat Commun. 2025;17:237.
49. Infante DD, Segarra OO, Redecillas SS, Alvarez MM, Miserachs MM. Modification of stool's water content in constipated infants: Management with an adapted infant formula. Nutr J. 2011;10:55.
50. Bronsky J, Campoy C, Embleton N, Fewtrell M, Mis NF, et al. Palm oil and beta-palmitate in infant formula. J Pediatr Gastroenterol Nutr. 2019;68:742-760.
51. Mukhtar K, Nawaz H, Abid S. Functional gastrointestinal disorders and gut-brain axis: What does the future hold? World J Gastroenterol. 2019;25:552-566.
52. Vandenplas Y, Gerlier L, Caekelbergh K, Possner M. An observational real-life study with a new infant formula in infants with functional gastro-intestinal disorders. Nutrients. 2021;13:3336.
53. Alexander DD, Yan J, Bylsma LC, Northington RS, Grathwohl D, et al. Growth of infants consuming whey-predominant term infant formulas with a protein content of 1.8 g/100 kcal: A multicenter pooled analysis of individual participant data. Am J Clin Nutr. 2016;104:1083-1092.
54. Rochat F, Cherbut C, Barclay D. A whey-predominant formula induces fecal microbiota similar to that found in breast-fed infants. Nutr Res. 2007;27:735-740.
55. Hascoët JM, Hubert C, Rochat F. Effect of formula composition on the development of infant gut microbiota. J Pediatr Gastroenterol Nutr. 2011;52:756-762.