



Prevalence and possible causes of crying and mild gastrointestinal and skin symptoms in infants reported by healthcare professionals - worldwide data

Vera Bunt¹ · Jildou Visser¹ · Fawaz AlRefaee² · Shannon Seckel³ · Mizu Jiang⁴ · Jinjin Chen⁵ · Irina Zakharova⁶ · Natalia Geppe⁷ · Christophe Dupont⁸ · Hania Szajewska⁹ · Dominique Goossens¹ · Lucie van der Zee¹ · Carina Venter¹⁰

Received: 10 March 2025 / Revised: 17 April 2025 / Accepted: 4 May 2025
© The Author(s) 2025

Abstract

Objective Many infants experience crying, mild gastrointestinal (GI) symptoms (such as regurgitation, constipation, and diarrhea) and skin symptoms during the first year of life. However, little is known about the prevalence and the management of these symptoms. The aim of this study was to gather insights in the experiences, prevalences, and potential causes of mild-to-moderate crying and GI and skin symptoms in healthy infants (< 12 months) as reported by health care professionals (HCPs) globally.

Methods The study was conducted among HCPs from six regions (China (CN), Europe (EU), Mexico (MX), Middle East (ME), Russia (RU), and the United States (US)). During qualitative interviews with selected experts, alignment on the definitions of crying and GI and skin symptoms and consensus on the survey were reached. The quantitative survey consisted of questions on the reported prevalence of study-defined symptoms in infants, potential causes, treatments, and the role of nutrition in these symptoms. Descriptive statistics were used to describe the prevalence, potential causes, and management of study-defined symptoms.

Results Definitions of crying, GI, and skin symptoms were formulated, supported by 17 in-depth expert interviews. Survey responses from 1047 HCPs were analyzed. The prevalence of study-defined symptoms was reported to be 60%; gas/bloating (22%) was the most prevalent GI symptom, followed by regurgitation (19%) and unexplained crying/colic (18%). The not yet fully developed infants' GI tract and the type of infants' nutrition were reported as the main causes of study-defined symptoms. To address infants' symptoms, HCPs most often recommend changes in feeding regimen (volume, position of the infant, feeding scheme) or in infants' nutrition, followed by parental advice and/or education.

Conclusion: HCPs reported that more than half of the infants experience at least one symptom in the first year of life. The ongoing development of the infant's GI tract and infant's nutrition were reported to be the main causes of study-defined symptoms. To manage infants' GI symptoms, HCPs recommend a change in feeding regimen or infants' nutrition along with parental education.

What is known?

- Infants experience unexplained crying and gastrointestinal (GI) and skin symptoms in the first year of life.
- The infant's gastrointestinal tract needs time to develop.

What is new?

- Health care professionals' (HCPs) consensus on the definitions of mild crying and GI and skin symptoms.
 - The reported prevalence of those symptoms is 60%, which is approximately twice as high as the prevalence of functional gastrointestinal diseases (FGIDs).
 - To manage those symptoms, HCPs give parental advice or education, or they recommend a change in feeding regimen or type of infants' nutrition.
-

Keywords Mild gastro-intestinal symptoms · Infant · Gas/bloating · Regurgitation · Colic/crying · Diagnosis · Treatment

Communicated by Peter de Winter.

Extended author information available on the last page of the article

Introduction

The first phase of life is an important period of rapid growth and development for infants. The majority of the infants experience gastrointestinal (GI) symptoms such as colic, regurgitation, constipation, and diarrhea during the first months of life [1]. A combination of persistent GI symptoms that cannot be explained by structural or biochemical abnormalities are classified as functional gastrointestinal disorders (FGID) by the Rome IV criteria [2] and might be referred to as disorders of the gut brain interaction (DGBI) when the Rome V criteria are published in 2026 [3]. Even though the Rome IV definitions were used to diagnose FGIDs in infants, reported prevalences range from 5 to 40% [4].

Many infants experience GI symptoms that are less severe than FGIDs, these are referred to as mild-to-moderate GI symptoms [5]. Studies suggest that more than half of the infants experience at least one mild GI symptom, of which regurgitation, gas/bloating, and colic are the most prevalent GI symptoms [5–8]. These symptoms are often attributed to the not yet fully developed GI tract [9, 10]. As some digestive enzymes are not yet fully active, partly indigested nutrients reach the colon, where they are fermented by gut microbiota causing gas formation resulting in a bloated feeling. Reflux and regurgitation are also common GI symptoms in infants. Normally the esophageal sphincter would prevent stomach content from flowing back to the esophagus. However, in infants the sphincters might not yet be fully developed and can be leaking, resulting in reflux or regurgitation [8–10].

GI symptoms, such as regurgitation and colic, often occur in the first weeks of life and can peak at different times. Colic tends to peak around 6–8 weeks, while regurgitation may be more prevalent between 1 and 4 months [5, 11–13]. As the GI tract develops, most GI symptoms naturally improve within a few months. Even though mild GI symptoms are a temporary issue, they do cause negative parental emotions like concern and anxiety and decrease parental quality of life [14, 15]. Many parents feel helpless and want to relieve GI symptoms to comfort their infant [14, 15], resulting in doctor visits and health care costs [7].

The aim of this study was to gather insight in the HCPs experience of crying and GI and skin symptoms in healthy

infants < 12 months of age globally. Insights on the prevalence, potential causes, diagnosis, and management of these GI symptoms are obtained. Study-defined symptoms are mild-to-moderate symptoms of gas/bloating, constipation, diarrhea, reflux, regurgitation, vomiting, unexplained crying/colic, and itchy dry-skin and/or skin rash.

Methods

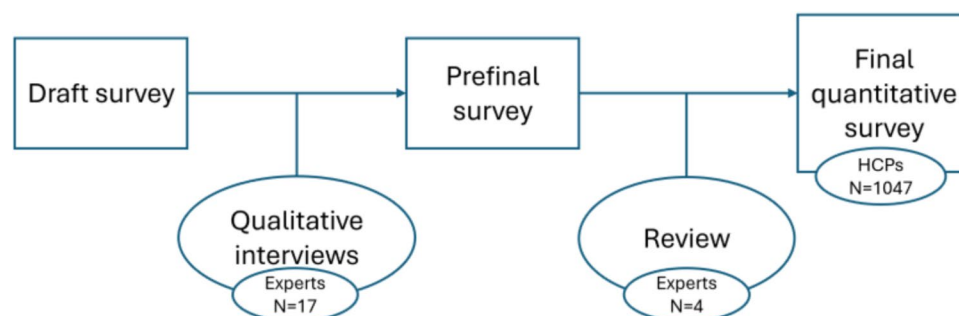
Study design

This study was conducted in two parts (Fig. 1). First, qualitative interviews were conducted to verify the developed questionnaire with key opinion leaders and HCPs in the pediatric field. Secondly, a quantitative survey was distributed to collect insight from a large group of HCPs worldwide. In both the interviews and the survey, HCPs from six regions (China (CN), Europe (EU), Mexico (MX), Middle East (ME), Russia (RU), and the United States (US)) participated. HCPs from the EU region were from the United Kingdom, the Netherlands, Germany, Poland, and France, and the ME region was represented by HCPs from the Kingdom of Saudi Arabia, Kuwait, and Egypt.

Qualitative interviews

Semi structured interviews were conducted via video calls (Zoom) between June and August 2023 by an independent agency (KOLgroups, LLC). In total, 17 selected pediatric experts shared their insights on the prevalence, causes, and management of study-defined symptoms in infants < 12 months of age. The main goal of the qualitative interviews was to consent on the drafted questionnaire, align the definitions of symptoms and gain insights in possible differences between regions and professions. In the interviews, all questions and answer options were discussed to ensure that all relevant insights are captured. During the interviews, all participants gave oral informed consent and permission to record the interview. Both informed consent and permission are registered in the interviews' recording and transcript.

Fig. 1 Study design



Quantitative questionnaire

Based on the interviews, the questionnaire was finalized and reviewed by four pediatric experts. The questionnaire was created in the online questionnaire program Qualtrics, consisted of 47 questions and could be completed within 15 min. Multiple HCPs with different specialties are involved in the first year of an infant's life. To minimize the effect of differences in health care roles, HCP that were active in one of the following professional roles were eligible; pediatrician, neonatologist, general practitioner, internal medicine, family doctor, maternity nurse, midwife, obstetrician, infant nutritionist, or dietician. They had at least 5 years of working experience and were attended by > 5 infants a month. Data was collected anonymously and participants' informed consent was obtained in the first question. The questionnaire consisted of questions about the respondents' demographics and professional characteristics, the reported prevalence of crying and GI and skin symptoms and food allergy in infants, and potential causes and treatments of these symptoms and nutritional components that could play a role in causing symptoms. The type of infant's nutrition was one of the possible causes of GI symptoms, meaning that the HCP suspected the type of formula or a specific component in the formula to cause the infant's symptoms. When a change in infant's nutrition is recommended, this does not indicate a change from breastmilk to formula. All other feeding practices are combined in the answer category feeding regimen, which includes volume of a feeding, position of the infant during feeding, and the feeding scheme. Most of the questions were multiple choice, the questions about the potential causes and treatments of study-defined symptoms allowed the respondents to select multiple answers and rank their answers.

The questionnaire was available in five languages: English (EU, ME, MX, US), Spanish (EU, MX), Chinese (CN), Russian (RU), and Arabic (ME). The translations were performed forward–backward by a professional translation agency. The translated questionnaire was reviewed by a native speaker KOL to confirm the contextual translation is correct and to prevent ambiguity. The survey study was carried out between October 2023 and January 2024.

Data analysis

HCPs who consulted less than 5 infants (younger than 12 months of age) per month were excluded for analysis. Descriptive statistics were used to summarize the characteristics of the respondents and their responses to the questions. The prevalence of crying and GI and skin symptoms was calculated as the mean of the prevalences reported by HCPs. To calculate the symptom specific prevalences, the frequency of each symptom was calculated and expressed as percentage of the total number of infants < 12 months per

HCPs. The mean of the reported frequency of symptoms per HCP is the prevalence of that symptom. Frequencies were used for questions where multiple answers were allowed, and percentages were calculated for single answer questions. In questions where the participant could rank their selected answers, percentages were calculated for the answers that were ranked number 1. The data was analyzed in the total group of HCPs, per region and per professional role. Outstanding difference are reported.

Results

Qualitative interviews

Seventeen interviews were conducted with pediatric experts from 6 regions, CN ($n = 2$), EU ($n = 4$), MX ($n = 2$), ME ($n = 3$), RU ($n = 2$), and US ($n = 4$), resulting in aligned definitions and the final questionnaire.

Various definitions of GI symptoms are used both in clinical practice and in scientific literature. In this study, definitions of symptoms were drafted based on literature [5, 16–22]. In the interviews, the definitions of crying and mild GI and symptoms are aligned and finalized as shown in Table 1.

Quantitative questionnaire

Study population

In total, data from 1047 HCPs was collected, of this group 55% was female, 70% was aged between 30 and 50, and on average, they had 14.6 years of work experience in the pediatric field. HCPs from three groups of specialisms were invited; pediatricians and neonatologists; general practitioners and family medicine; and maternity nurse, midwife, and infant nutritionists. On average, the HCPs indicated to see 101 infants each month. The characteristics of the participating HCPs are shown in Table 2.

Prevalence of study-defined symptoms per region

The reported prevalence of mild symptoms in infants < 12 months of age was 60% and HCPs reported that 25% of their infant patients experience 2 or more symptoms. Comparing the six regions, the highest prevalence of study-defined symptoms was reported by HCPs in the ME (74%) and the lowest by HCPs in the US (49%). HCPs from the ME also reported the highest percentage of their infant patients to be affected by at least 2 symptoms (35%), whereas CN, EU, and US HCPs reported the lowest percentage of multiple symptoms (19%) (Fig. 2a).

In EU, MX, and US, the group of general practitioners/family medicine reported the highest prevalence of mild

Table 1 Definitions of unexplained crying and mild-to-moderate gastrointestinal (GI) and skin symptoms

Study-defined symptoms	Definition
Gas/bloating	Burping, passing gas, bloating, (feeling that stomach is over full or stretched) and/or flatulence (≥ 1 week duration)
Constipation	Difficult defecation characterized by 1 bowel movement (defecation) every 3 days or more, often associated with crying fits (≥ 1 week duration)
Diarrhea	Watery/liquid stools (≥ 1 week duration)
Reflux	The involuntary retrograde passage of gastric contents into the esophagus with or without regurgitation or vomiting. It is a frequently experienced physiologic condition occurring several times a day ≥ 1 week, mostly postprandial and causes no symptoms
Regurgitation	The loss of a small part of the meal, without retching (≥ 1 week)
Vomiting	The loss of a consistent part (about 50% or more) of the previous meal, after retching (≥ 1 week)
Unexplained crying/colic	Prolonged fits of crying, without any obvious cause, with a mean daily duration of 1–3 h, for more than 3 days/week (≥ 1 week)
Itchy-dry skin and/or skin rash	Itchy skin (scratching or rubbing the skin) and/or skin rash (≥ 1 week)

symptoms, while in CN, ME, and RU, the maternity nurse/midwife/infant nutritionist reported the highest prevalence. The variation was largest between the Russian HCPs, varying from 58% (reported by pediatricians/neonatologist) to 78% reported by the group maternity nurse/midwife/infant nutritionist. In the ME all specialty groups reported a prevalence of 74%.

The most prevalent symptom was gas/bloating (22%), followed by regurgitation (19%), unexplained crying/colic (18%), reflux (17%), and diarrhea (17%). HCPs from the ME reported the highest prevalence for most symptoms; only for regurgitation and itchy-dry skin and/or skin rash Russian HCPs reported higher prevalences. Gas/bloating was reported to be the most prevalent GI symptom in CN (20%), EU (18%), ME (34%), MX (17%), and US (16%), whereas in RU, regurgitation was the most prevalent GI symptoms, with a reported prevalence of 31%. CN reported low prevalences of unexplained crying and itchy-dry skin (Fig. 2b).

Diagnostic methods

To diagnose study-defined symptoms in infants most of the HCPs (88%) indicated that they use physical examination. Medical history is the second most used diagnostic method, selected by 82% of the HCPs. Other tools that were used are family history (60%), allergy test (58%), stool samples (58%), and validated questionnaire (49%). Differences were seen between the regions, especially in the use of stool samples. In CN, 67% of the HCPs indicated using stool samples in the diagnosis of GI symptoms, while in EU, only 39% of the HCPs uses stool samples.

The number of HCPs that selected physical examination as diagnostic tool was higher than the number of HCPs that selected medical history. However, medical history was ranked as the number 1 diagnostic tools by a larger portion of HCPs (40%) than physical examination (31%).

Management study-defined symptoms

Causing study-defined symptoms There are several factors that can cause mild symptoms in infants (Fig. 3). For gas/bloating the development of the infant's GI tract is considered most important (37%). In MX HCPs reported intolerance to nutritional ingredients as most likely, which is the second suspected cause worldwide. Intolerance to nutritional ingredients was mainly first ranked by maternity nurses/midwives/infant nutritionists.

Constipation, reflux, regurgitation, vomiting, and crying were reported to be most likely caused by the development of the infant's GI tract. No differences in regions or professional roles were seen for the symptoms constipation and reflux. For vomiting and regurgitation the US HCPs ranked feeding regimen more often as most likely cause, followed by infant's developing GI tract. In ME and MX, HCPs reported intolerance to nutrition ingredients as most important cause for unexplained crying.

Diarrhea and itchy-dry skin was mostly reported to be caused by intolerance to nutritional ingredients.

Additionally infection is reported as one of the three most likely causes for both diarrhea and itchy-dry skin. ME HCPs ranked infection as first suspected cause of these symptoms, while in EU mainly diarrhea is linked to infection.

The type of infant's nutrition was considered as an important cause in itchy-dry skin and/or skin rash, constipation, and gas/bloating (Fig. 3).

Addressing study-defined symptoms For all symptoms a change in infant's nutrition, parental advice and a change in feeding regimen were considered most common ways to address crying and mild GI and skin symptoms (Fig. 4). For diarrhea and itchy-dry skin the prescription of medicine

Table 2 The demographic and self-reported characteristics of the respondents of the questionnaire ($n = 1047$)

Characteristics	Demographic data	Number	Percent
Region	China (CN)	151	14.4%
	Europe (EU)	145	13.8%
	Mexico (MX)	145	13.8%
	Middle East (ME)	233	22.3%
	Russia (RU)	131	12.5%
	United States of America (US)	242	23.1%
Sex	Male	580	37.0%
	Female	387	55.4%
	Prefer not the answer	11	1.1%
	Missing	69	6.6%
Age group	20–29 years	43	4.1%
	30–39 years	363	34.7%
	40–49 years	369	35.2%
	50–59 years	191	18.2%
	60–69 years	67	6.4%
	70–79 years	13	1.2%
Specialty	Pediatrician/neonatologist	372	35.5%
	<i>Pediatrician</i>	- 288	
	<i>Neonatologist</i>	- 84	
	General practitioner/internal medicine/family medicine*	352	33.6%
	Maternity nurse/midwife/infant nutritionist/obstetrician	322	30.8%
	<i>Maternity nurse</i>	- 154	
	<i>Infant nutritionist</i>	- 75	
	<i>Midwife</i>	- 66	
Years of experience in the pediatric area	<i>Obstetrician</i>	- 27	
	5 years or less	70	6.7%
	From 6 to 10 years	412	39.4%
	From 11 to 20 years	342	32.7%
	More than 20 years	215	20.5%
Work setting	Hospital-affiliated outpatient practice	282	26.9%
	Private hospital	290	27.7%
	Government hospital	328	31.3%
	Government clinic	77	7.4%
	Combination of work settings	46	4.4%
	Something else	19	1.8%

*This group was not specified in individual specialty

was the first chosen method for 17% and 19% of the HCPs respectively. Especially HCPs from ME reported to prescribe medicine for those two symptoms.

Gas/bloating was most commonly addressed in CN and ME by a change in feeding regimen, in MX by a change in infant's nutrition and in EU, RU, and US by parental advice. The majority of the HCPs that address gas/bloating by a change in feeding regimen are maternity nurses/midwives/infant nutritionists.

Regurgitation is in ME and MX mainly addressed by a change in infant's nutrition. In RU HCPs allow time to resolve the regurgitation, as this method is most often first ranked.

Crying is in EU, ME, and US mainly addressed by parental advice/counseling. The approach to improve unexplained crying differs per professional role, maternity nurses/midwives/infant nutritionists prefer a change in feeding regimen, general practitioner/internal medicine/family medicine mostly recommend a change in infant's nutrition, while parental advice/reassurance is mostly first ranked by pediatricians and neonatologist.

Reflux was addressed by a change in feeding regimen (29%) or a change in infant's nutrition (20%), there were no differences between the regions or professional roles.

Itchy-dry skin is in EU and RU mainly addressed by parental advice, while the other regions ranked a change in infant's nutrition highest.

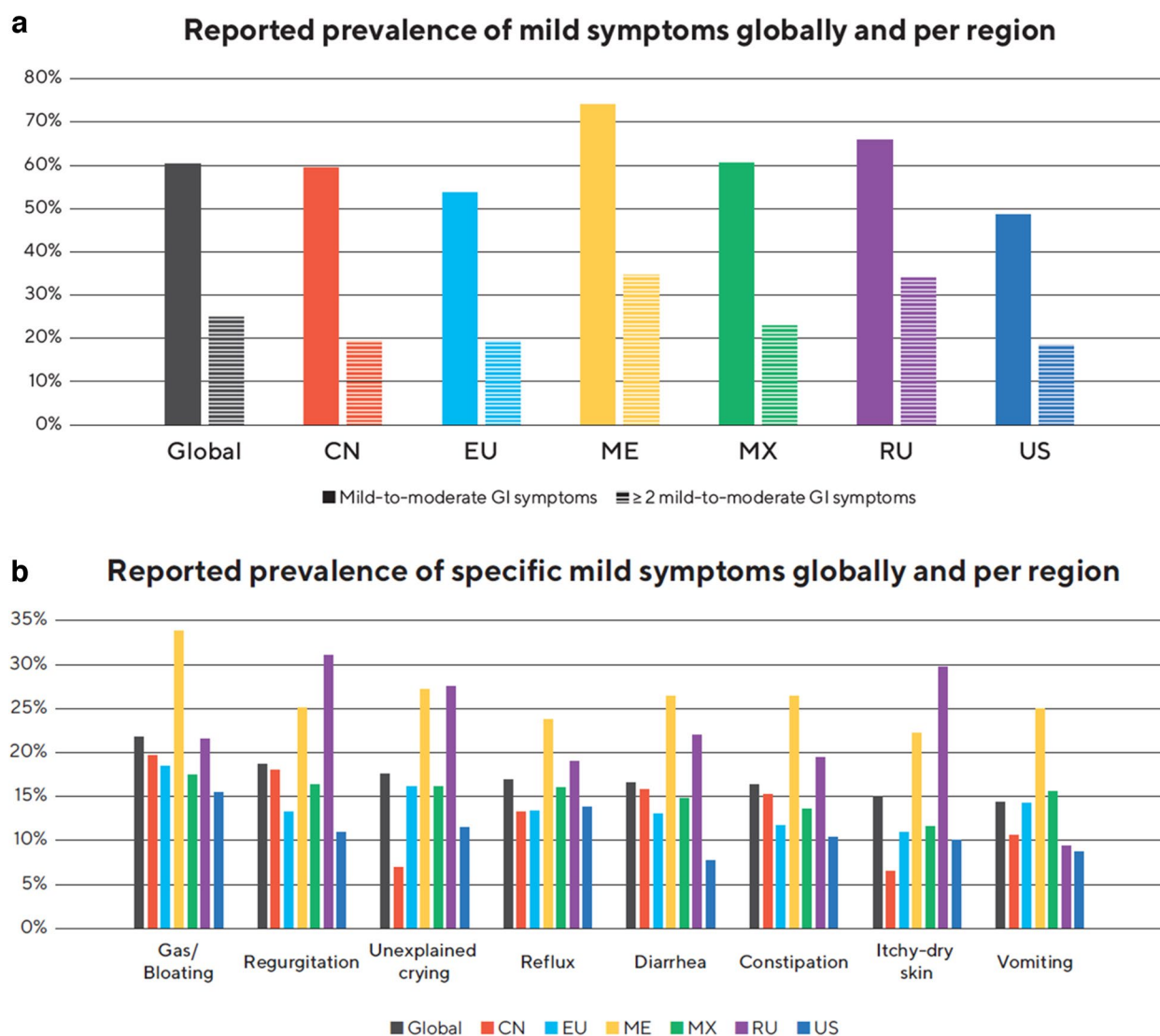


Fig. 2 **a** Reported prevalence of crying and mild GI and skin symptoms globally and per region (solid bar) and reported prevalence of ≥ 2 symptoms globally and per region (striped bar). **b** Reported

prevalence of specific symptoms globally and per region (CN: China; EU: Europe; ME: Middle East; MX: Mexico; RU: Russia; US: United States)

Regional differences are seen in the way HCPs address diarrhea, constipation, and vomiting. CN HCPs recommend a change in feeding regimen, EU HCPs focus mainly on parental advice and parental counseling, and ME HCPs prescribe medicine for diarrhea. Worldwide, a change in infant's nutrition is mostly first ranked as a way to address constipation (27%), in CN a change in feeding regimen and in US parental advice/education is preferred. Vomiting was by CN and US HCPs mainly addressed by a change in feeding regimen; in EU and MX, a change in infant's nutrition or parental advice was mostly used; in RU, parental advice was chosen to address vomiting; and ME HCPs prescribe medicine.

Managing study-defined symptoms To support HCPs in the management of symptoms in infants, documents (such

as guidelines, consensus papers, definitions, or educational materials), diagnostic methods and information on medication or infant formula could be helpful. 34% of the HCPs ranked "pediatric consensus and guidelines concerning the management of GI symptoms" as most helpful for them in the management of GI symptoms in their patients. The second most often selected support is "patient education materials (pamphlet, website, etc.)" (23%), followed by "infant formula proven to treat mild GI symptoms" (16%).

Parental quality of life and emotions

The parental quality of life is reported by HCPs as "very good" or "good" for respectively 32% and 37% of the parents with an infant that experiences study-defined

Most common reported cause of mild symptoms in infants <12 months

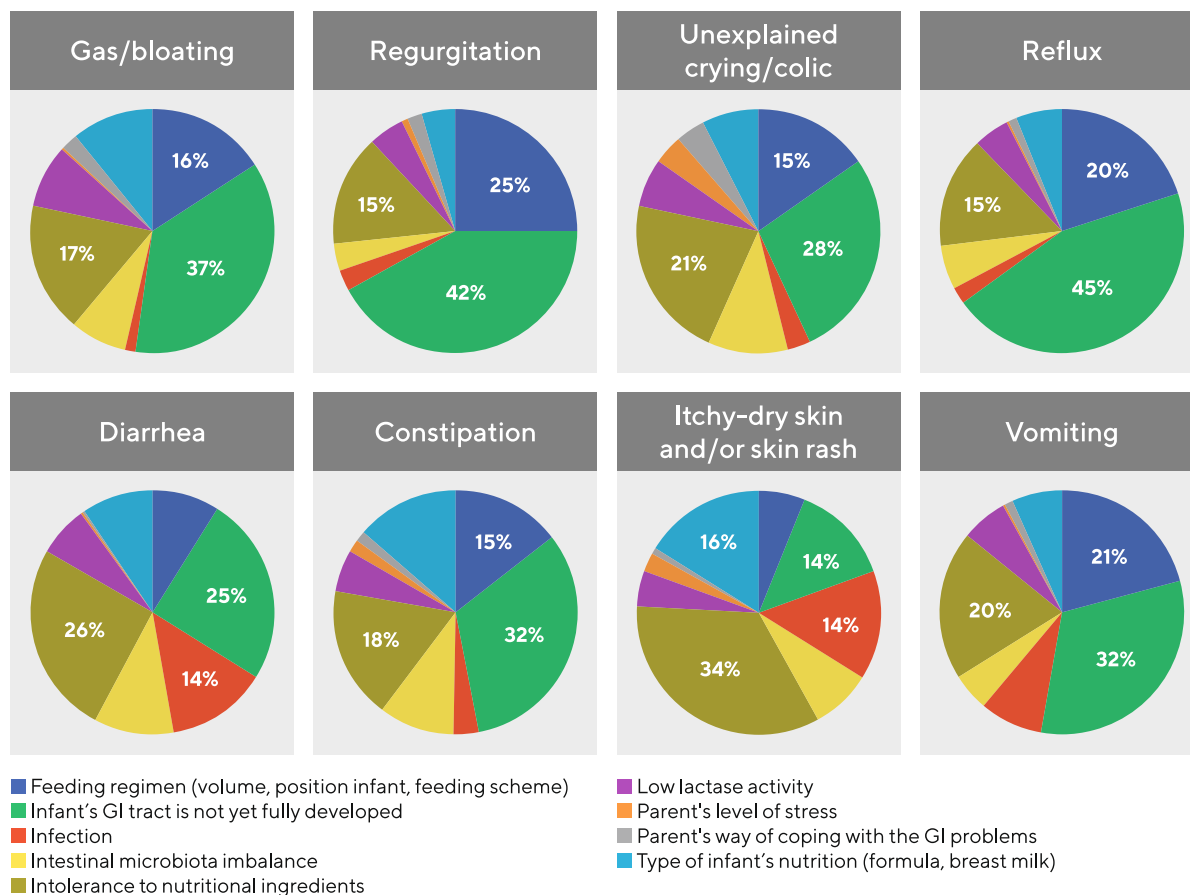


Fig. 3 Percentage of HCPs that ranked a specific cause of crying and mild GI and skin symptoms in infants < 12 months as number 1 cause

symptoms. However, according to HCPs, there are also parents that experience a “poor” (21%) and a “very poor” (10%) quality of life.

More than half of the HCPs indicated concern and anxiety in parents of an infant with symptoms. According to HCPs, 62% of the parents experience concern, and 52% of the parent experience anxiety. Other common emotions are frustration, according to HCPs experienced by 53% of the parents, and sleep deprivation, experienced by 52% of the parents.

Discussion

HCPs globally report a prevalence of 60% for mild symptoms in healthy infants < 12 months of age. The most prevalent symptoms are gas/bloating, regurgitation, unexplained crying/colic, and reflux. One in four infants were reported to experience ≥ 2 mild symptoms. Study-defined

symptoms were considered to be caused by the fact that the infants' developing GI tract, feeding regimen, intolerance to nutritional ingredients, and the type of infants' nutrition. To address infants' symptoms, HCPs often recommend a change in feeding regimen or a change in infants' nutrition. When a change in feeding regimen is advised, the volume and frequencies of feedings and the position of the infant are adjusted. A change in infant's nutrition indicates in change in infant formula.

The prevalences reported by the HCPs in this study are comparable to previous research on mild crying and GI and skin symptoms [5, 23–26]. The prevalence of mild GI symptoms is higher than the prevalence of FGIDs, which is reported to be up to 30% [1, 4]. Mild GI symptoms are thereby about twice as prevalent as FGIDs in infants. The prevalences of study-defined symptoms in infants differ per region, HCPs from ME and RU reported higher prevalences, compared to the other four regions. This could indicate a true difference in the prevalence of symptoms

Most common way to address mild symptoms in infants <12 months

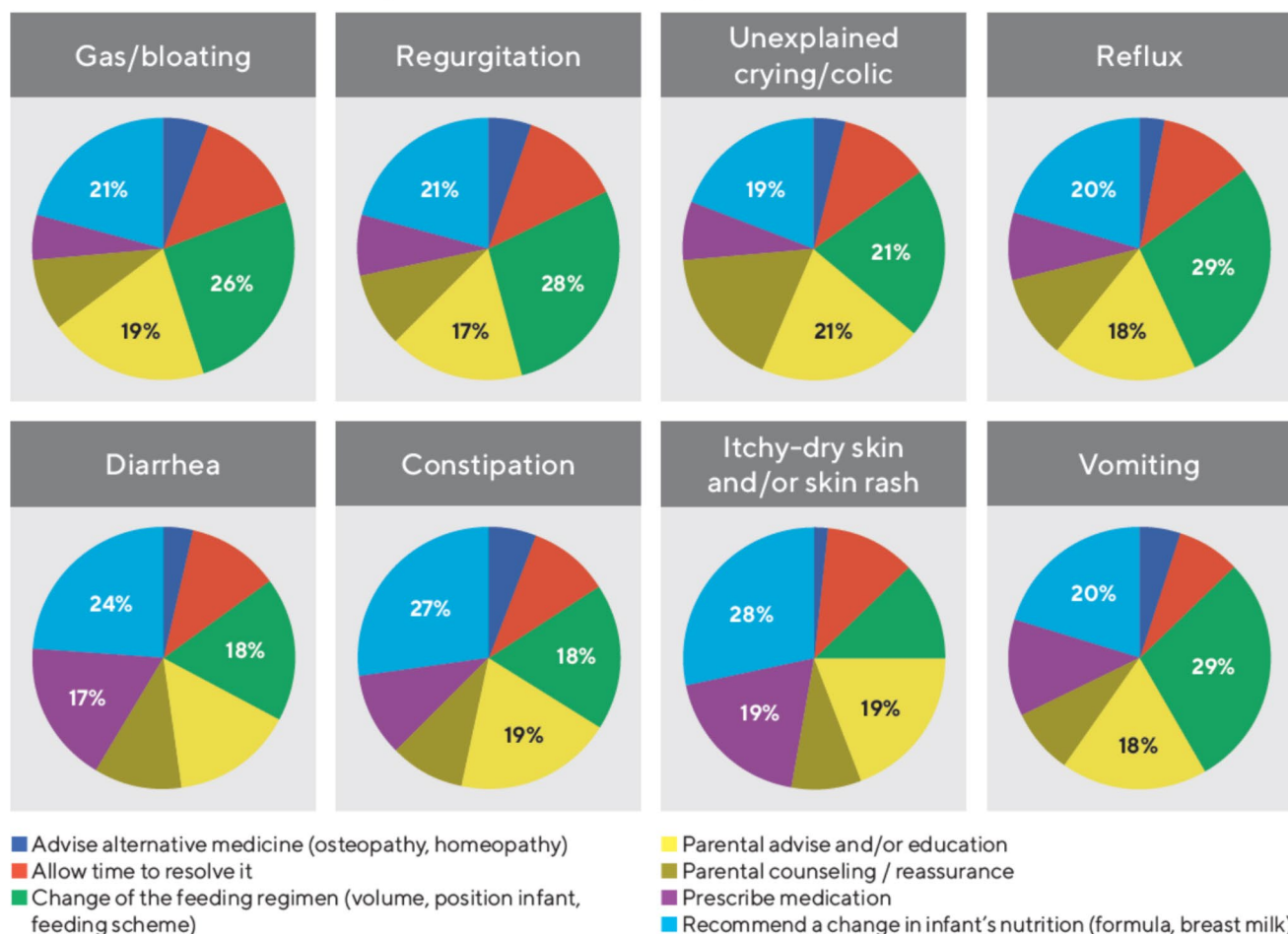


Fig. 4 Percentages of HCPs that ranked a specific way to address crying and mild GI and skin symptoms in infants <12 months as number 1 method

between regions. However, the data in this study is reported by HCPs, therefore the differences could also be influenced by differences in medical opinion, health care systems, or cultural differences. In this study, the specialty that reported the highest prevalence of mild symptoms varied between regions, indicating that there are regional differences in which infants attend which specialization. This affirms the inclusion of HCPs with various specialisms to get the most accurate prevalence in the patient population.

Even though crying and GI and skin symptoms are usually not harmful for the infant and mostly resolves naturally, more than half of the infant population experience discomfort from these symptoms. Infants' symptoms can have an impact on the whole family, as previous studies reported a negative effect on quality of life [14, 27, 28]. This study supports the findings of previous studies, as HCPs reported that more than 30% of the parents of an infant with GI symptoms experience a "poor" or "very

poor" quality of life. Many parents of infants with GI symptoms experience negative emotions like concern, frustration, anxiety, and sleep deprivation. It is known that concerned parents of infants with study-defined symptoms are more likely to attend HCPs to address the infants' symptoms [7, 8]. In the qualitative interviews, one expert even called this a vicious cycle, in which the parents' stress and anxiety and the infants' symptoms could affect each other. This implies that, in addition to addressing the infant's symptoms, HCPs should educate parents that some symptoms are part of the infant's development and may not be a reason for concern. Overall, 15–21% of the HCPs indicated that they use parental advise and/or education to address mild symptoms. The importance of parental education was described previously for infants with FGIDs [19, 29], and is now indicated as a way to address mild GI symptoms in infants as well. Parents should be informed about the occurrence and the course of GI symptoms in

healthy infants. Understanding that the symptoms are temporary and will improve over time, may relieve concern and stress in the parents.

An interesting finding of this study is that HCPs indicate that guidelines and patient education materials would support them in the management of mild GI symptoms. There are guidelines for the treatment and management of FGID in infants [19, 30]; however, such guidelines do not exist for mild-to-moderate crying and GI and skin symptoms. HCP's perspective on potential causes and best ways to address GI symptoms could be helpful in creating pediatric consensus papers and guidelines.

The digestive system of an infant is not fully developed shortly after birth [9, 10], HCPs reported this as the main cause of mild symptoms. Even though the GI tract and the microbiome require time to develop, this process can be supported by nutrition. Human milk oligosaccharides (HMOs), pre- and probiotics are nutritional components that can support the development of the gut microbiome [31–33]. Exclusive breastfeeding is recommended for the first 6 months of life [34]. Human milk is the optimal type of infants' nutrition, and contains bioactive components to support infants' development in the first months of life [35]. In breast-fed infants experiencing GI discomfort, HCPs should continue to support breastfeeding [29]. In formula-fed infants a change in type of formula can be recommended.

For mild crying and GI and skin symptoms, some HCPs, mainly from the ME region, prescribe medication (percentages ranging from 6 to 19%). ME HCPs reported infection as an important cause for diarrhea and itchy-dry skin, which is coherent with the finding that medicine is mostly prescribed for those symptoms by this region. Overall most HCPs prefer parental advice or reassurance and a change in feeding regimen or type of infant's nutrition over a pharmacological approach. This is in line with the results of a previous HCP survey study on the reported choices to manage functional constipation in toddlers. In toddlers 28% of the HCPs reported to address functional constipation by the prescription of medicine, 32% reported reassurance of parents as the first choice, but largest group of HCPs (40%) preferred a nutritional solution [36].

In the qualitative interviews several HCPs mentioned that the volume, the position of the infant and burping after the feed are important to reduce GI discomfort. Overfeeding can be a cause of regurgitation and reflux [19, 29]. More frequent feedings of a smaller volume can help reduce reflux, regurgitation, and post feed discomfort.

Strength and limitations

The main strength of this study is that it includes a large sample of experts from various specialties from all over

the world. It confirms the previously reported prevalences of mild GI symptoms in infants and gives new information on regional differences. Definitions of crying and GI and skin symptoms were formulated based on both scientific literature and pediatric experts' experiences from clinical practice. In this study, data from six regions is collected which makes it possible to compare between the regions. Another strength is that this study gives a complete overview of the prevalence, diagnostic tools, suspected causes, and treatments of the symptoms in infants < 12 months.

On the other hand, this study also has some limitations. Even though a large number of HCPs was included, this study used a convenience sample which might not represent all HCPs worldwide. From the differences that are seen in the reported prevalence of GI symptoms we cannot conclude that GI symptoms are less prevalent in infants in a specific region. The prevalences of study-defined symptoms was reported retrospectively, based on memory instead of medical dossiers or observational research. The parental quality of life and emotions are important aspects in the management of mild symptoms in infants, in this study the data was recorded by the HCPs. The data on parental quality of life and emotions would be stronger and more accurate if collected directly from the parents.

Further research

Numerous research studies have been done on FGIDs, however sparse data is available on mild GI symptoms in infants. As many infants and their families are affected by mild GI symptoms, more research should focus on these symptoms. Research on the need and effectiveness of treatments, interventions, and educational tools for specific GI symptoms in infants could largely impact family quality of life, and ultimately reduce the number of HCPs visits and the health care costs. This survey gained insights on HCPs perspective, but an intervention study can determine if there is a causal relationship between the recommendations from HCPs and the symptoms infants experience.

Conclusion

Mild GI symptoms are common in infants during the first year of life. These symptoms were considered to be caused by the infants' developing GI tract, feeding regimen and infants' nutrition. The global average reported prevalence of mild GI symptoms is 60%, with the highest prevalence reported in the Middle East and Russia. Even though these symptoms are considered common in this phase of the infants' development, they cause discomfort in the infant and concern in their parents. The main strategies HCPs use in the management of mild GI symptoms are parental advice,

and recommendations on infants' feeding regimen and/or the type of infants' nutrition.

Authors contributions VB contributed to formal analysis, visualisation and writing—original draft preparation. JV contributed to conceptualization, methodology, project administration and writing—original draft preparation. FR, SS, MJ, JC, IZ, NP, CP, HS and CV contributed to the investigation. DG contributed to conceptualization and methodology. LZ contributed to conceptualization and resources. All authors reviewed and edited the manuscript.

Funding This study was funded by Ausnutria B.V.

Data availability Data is available from the authors upon reasonable request.

Declarations

Ethics approval This survey study is conducted in health care professionals and no patient data is collected. Where applicable the study was conducted in accordance to the declaration of Helsinki.

Informed consent Verbal and recorded informed consent was obtained from all experts that participated in the qualitative interviews. Written informed consent was obtained from all participants in the quantitative survey.

Competing interests The authors VB, JV, DG and LvdZ are employed at Ausnutria B.V. HS has participated as a clinical investigator or advisory board member or consultant or speaker for: Arla, Ausnutria, Bio-Gaia, Biocodex, Danone, Dicoform, Nestlé, Nestlé Nutrition Institute, Nutricia, Mead Johnson/RB, and Winclive. CD has provided consultancy or educational materials for Ausnutria, Abbott, Danone, Nestle Nutrition Institute, Reckitt and Novalac. CV has provided consultancy or educational material for Ausnutria, Abbott, Danone, Nestle Nutrition Institute and Reckitt.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.


References

- Vandenplas Y et al (2015) Prevalence and health outcomes of functional gastrointestinal symptoms in infants from birth to 12 months of age. *J Pediatr Gastroenterol Nutr* 61(5):531–537
- Drossman DA (2016) Functional gastrointestinal disorders: history, pathophysiology, clinical features, and Rome IV. *Gastroenterology* 150(6):1262–1279. e2
- Drossman DA, Tack J (2022) Rome foundation clinical diagnostic criteria for disorders of gut-brain interaction. *Gastroenterology* 162(3):675–679
- Vernon-Roberts A, Alexander I, Day AS (2021) Systematic review of pediatric functional gastrointestinal disorders (Rome IV criteria). *J Clin Med* 10(21):5087
- Iacono G et al (2005) Gastrointestinal symptoms in infancy: a population-based prospective study. *Dig Liver Dis* 37(6):432–438
- Foster JP et al (2022) Probiotics for preventing and treating infant regurgitation: a systematic review and meta-analysis. *Matern Child Nutr* 18(1):e13290
- Steutel NF et al (2014) Reporting outcome measures in trials of infant colic. *J Pediatr Gastroenterol Nutr* 59(3):341–346
- van de Heijning BJ et al (2014) GI symptoms in infants are a potential target for fermented infant milk formulae: a review. *Nutrients* 6(9):3942–3967
- Neu J (2007) Gastrointestinal maturation and implications for infant feeding. *Early Hum Dev* 83(12):767–775
- Hamosh M (1996) Digestion in the newborn. *Clin Perinatol* 23(2):191–209
- Barr RG (1990) The normal crying curve: what do we really know? *Dev Med Child Neurol* 32(4):356–362
- Wolke D, Bilgin A, Samara M (2017) Systematic review and meta-analysis: fussing and crying durations and prevalence of colic in infants. *J Pediatr* 185:55–61.e4
- Jung AD (2001) Gastroesophageal reflux in infants and children. *Am Fam Physician* 64(11):1853–1861
- Jung C et al (2017) Quality of life of infants with functional gastrointestinal disorders: a large prospective observational study. *Int J Child Health Nutr* 6:62–69
- Megel ME et al (2011) Baby lost and found: mothers' experiences of infants who cry persistently. *J Pediatr Health Care* 25(3):144–152
- Hasler WL (2006) Gas and Bloating. *Gastroenterol Hepatol (N Y)* 2(9):654–662
- Riley A et al (2015) Validation of a parent report questionnaire: the infant gastrointestinal symptom questionnaire. *Clin Pediatr* 54(12):1167–1174
- Huang Y et al (2021) The effects of a partially hydrolyzed formula with low lactose and probiotics on mild gastrointestinal disorders of infants: a single-armed clinical trial. *Nutrients* 13(10):3371. <https://doi.org/10.3390/nu13103371>
- Vandenplas Y et al (2013) Practical algorithms for managing common gastrointestinal symptoms in infants. *Nutrition* 29(1):184–194
- Vandenplas Y et al (2022) The cow's milk related symptom score: the 2022 update. *Nutrients* 14(13):2682. <https://doi.org/10.3390/nu14132682>
- Sherman PM et al (2009) A global, evidence-based consensus on the definition of gastroesophageal reflux disease in the pediatric population. *Am J Gastroenterol* 104(5):1278–95
- Williams HC et al (1994) The UK working party's diagnostic criteria for atopic dermatitis I Derivation of a minimum set of discriminators for atopic dermatitis. *Br J Dermatol* 131(3):383–96
- Loening-Baucke V (2005) Prevalence, symptoms and outcome of constipation in infants and toddlers. *J Pediatr* 146(3):359–363
- Kucukosmanoglu E et al (2008) Prevalence of immediate hypersensitivity reactions to cow's milk in infants based on skin prick test and questionnaire. *Allergol Immunopathol* 36(5):254–258
- Wadonda-Kabondo N et al (2003) A prospective study of the prevalence and incidence of atopic dermatitis in children aged 0–42 months. *Br J Dermatol* 149(5):1023–1028
- Martin P et al (2013) The prevalence and socio-demographic risk factors of clinical eczema in infancy: a population-based observational study. *Clin Exp Allergy* 43(6):642–651
- Bellaiche M et al (2018) Multiple functional gastrointestinal disorders are frequent in formula-fed infants and decrease their quality of life. *Acta Paediatr* 107(7):1276–1282

28. Abacı FB et al (2013) Psychosocial status and quality of life in mothers of infants with colic. *Turk J Pediatr* 55(4):391–395
29. Salvatore S et al (2018) Review shows that parental reassurance and nutritional advice help to optimise the management of functional gastrointestinal disorders in infants. *Acta Paediatr* 107(9):1512–1520
30. Zeevenhooven J, Koppen IJ, Benninga MA (2017) The new Rome IV criteria for functional gastrointestinal disorders in infants and toddlers. *Pediatr Gastroenterol Hepatol Nutr* 20(1):1–13
31. Hill DR, Chow JM, Buck RH (2021) Multifunctional benefits of prevalent HMOs: implications for infant health. *Nutrients* 13(10):3364
32. Miqdady M et al (2020) Prebiotics in the infant microbiome: the past, present, and future. *Pediatric Gastroenterology, Hepatology & Nutrition* 23(1):1
33. Ames SR, Lotoski LC, Azad MB (2023) Comparing early life nutritional sources and human milk feeding practices: personalized and dynamic nutrition supports infant gut microbiome development and immune system maturation. *Gut Microbes* 15(1):2190305
34. World Health Organization (2011) Exclusive breastfeeding for six months best for babies everywhere. from <https://www.who.int/news/item/15-01-2011-exclusive-breastfeeding-for-six-months-best-for-babies-everywhere>
35. Brockway MM et al (2024) Human milk bioactive components and child growth and body composition in the first 2 years: a systematic review. *Adv Nutr* 15(1):100127
36. West LN et al (2022) Reported prevalence and nutritional management of functional constipation among young children from healthcare professionals in eight countries across Asia, Europe and Latin America. *Nutrients* 14(19):4067

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Authors and Affiliations

Vera Bunt¹  · Jildou Visser¹ · Fawaz AlRefaee² · Shannon Seckel³ · Mizu Jiang⁴ · Jinjin Chen⁵ · Irina Zakharova⁶ · Natalia Geppe⁷ · Christophe Dupont⁸ · Hania Szajewska⁹ · Dominique Goossens¹ · Lucie van der Zee¹ · Carina Venter¹⁰

✉ Vera Bunt
vera.bunt@ausnutria.nl

- ¹ Ausnutria B.V, P.O. Box 50078, 8002 LB Zwolle, The Netherlands
- ² Pediatrics Department, Al-Adan Hospital, Ministry of Health, Kuwait City, Kuwait
- ³ Texas Tech University Health Science Center, Lubbock, TX, USA
- ⁴ Department of Gastroenterology and Pediatric Endoscopy Center, Children's Hospital, Zhejiang University School of Medicine, National Clinical Research Center for Child Health, National Children's Regional Medical Center, Hangzhou 310052, China
- ⁵ Shanghai Children's Hospital Affiliated to Shanghai Jiaotong University, Shanghai, China

- ⁶ Children City Clinical Hospital Named After Z.A. Bashlyeva, Head of Pediatrics Department, Russian Academy of Education, Moscow, Russia
- ⁷ I.M. Sechenov First Moscow State Medical University, Moscow, Russia
- ⁸ Clinique Marcel Sembat, Ramsay Group, Boulogne-Billancourt, France
- ⁹ Department of Paediatrics, The Medical University of Warsaw, 02-091 Warsaw, Poland
- ¹⁰ Section of Allergy & Immunology, School of Medicine, University of Colorado Denver, Children's Hospital Colorado, Anschutz Medical Campus, Aurora, CO, USA