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Prevalence and Risk Factors of Functional Gastrointestinal Disorders in Infants in Indonesia

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ABSTRACT

Purpose: Information regarding functional gastrointestinal disorders (FGIDs) in infants is currently lacking in Indonesia. This study aimed to describe the prevalence and risk factors of FGIDs in infants aged 6 weeks to 4 months in Indonesia.
Methods: This cross-sectional study of 433 infants was conducted between September 2018 and February 2020. Information on FGIDs was collected using the Infant Gastrointestinal Symptom Questionnaire and the Feeding Practice and Gut Comfort Questionnaire. Adapted Rome IV criteria were used to define the FGIDs.
Results: The prevalence of regurgitation was 26.3%; 16.8% of the infants presented crying-related symptoms and 5.5% exhibited constipation. The statistical analyses revealed that constipation was associated with sex (odds ratio [OR], 2.74; 95% confidence interval [CI], 1.07–7.71; p=0.043), employment of the father (OR, 0.3; 95% CI, 0.12–0.77; p=0.01), and education of the mother (OR, 1.92; 95% CI, 1.07–3.51; p=0.031). Length at birth (OR, 0.74; 95% CI, 0.55–0.99; p=0.042) was associated with constipation. Length at visit (OR, 0.83; 95% CI, 0.76–0.91; p<0.001) was associated with regurgitation, and the weight at visit (OR, 0.58; 95% CI, 0.35–0.96; p=0.038) was associated with crying and/or colic. A history of parental FGIDs was associated with crying-related symptoms (OR, 2.12; 95% CI, 1.23–3.68; p=0.007).
Conclusion: Regurgitation, crying, and constipation are common FGIDs in infants. Some parental and infant characteristics may be predictors for FGIDs. Further investigations are needed to evaluate the clinical relevance of our findings. Understanding the determinants of FGIDs will benefit healthcare professionals and parents to improve infant's quality of life and better manage these condition.

Keywords: Constipation; Colic; Crying; Gastroesophageal reflux; Indonesia; Infant

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Conflict of Interest
YW and CM are employees of Nestle Indonesia and Nestle Research, Lausanne, Switzerland. The other authors report no conflict of interest for this manuscript.

INTRODUCTION

Functional gastrointestinal disorders (FGIDs) are characterized by chronic or recurrent gastrointestinal (GI) symptoms that cannot be explained by structural or biochemical abnormalities [1]. The Rome diagnostic criteria have been developed via evidence-based research and consensus [2].

Regurgitation, infantile colic, and functional constipation are common FGIDs in infants [3-5]. Generally, the symptoms will improve as the infant grows and develops, except for constipation, which tends to persist [1].

The prevalence of FGIDs in infants and toddlers varies by country (**Table 1**). A literature search from 30 studies worldwide identified a prevalence of infantile colic between 2% and 73% (median 17.7%); 13 studies showed a prevalence of regurgitation from 3 to 87% (median 26.7%) and eight studies reported a prevalence of functional constipation in 0.05–39.3% (median 7.8%) [5]. The prevalence of any FGID in European infants (0–12 months) is reportedly 24.7% [4]. A Chinese study involving 2,604 children revealed a prevalence of infant regurgitation at 33.9% (0–6 months), colic at 43.8% (1–2 months), and constipation at 7% (7 months–4 years) [6]. A Turkish study among 2,383 infants (1–12 months) reported a prevalence of infant colic in 19.2%, regurgitation in 13.4%, and infant dyschezia in 9.8% [7]. Data from Malaysia reported the prevalence of regurgitation (10.5%), colic (1.9%), and functional constipation (1.1%) [8]. Hegar et al. [9] reported that 73% of Indonesian infants

Table 1. Prevalence of FGIDs and combined FGID in some countries

Reference	N	FGID (%)	Regurgitation (%)	Constipation (%)	Crying/colic (%)	Combined (%)
This study	433 (6 wk–4 mo)	48.7	26.3	5.5	16.8	8.1
Europe (Steutel et al. [4], 2020)	2,751 (0–48 mo)	24.7 (0–12 mo) 11.3 (13–48 mo)	13.8 (0–12 mo)	9.6 (13–48 mo)	NA	NA
Review (Vandenplas et al. [5], 2015)	<12 mo	NA	3–87‡ 30¶	0.05–39.3§ 15¶	2–73‖ 20¶	NA
China (Huang et al. [6], 2021)	2,604 (0–4 y)	27.3	33.9 (0–6 mo)	7.0 (1–4 y)	43.8 (1–2 mo)	3.72 (>1 FGID) 2.73 (most combination: regurgitation+colic)
Turkiye (Beser et al. [7], 2021)	2,383 (1–12 mo)	35.1	13.4	4.7	19.2	24
Malaysia (Chew et al. [8], 2021)	534 (<12 mo)	14.6	10.5	1.1	1.9 (n=160, <5 mo old)	0.37 (regurgitation+rumination syndrome)
Indonesia (Hegar et al. [9], 2009)	130 (0–5 y)	NA	73 (at 0–1 mo) 50 (at 5 mo) 4 (at 12 mo)	NA	NA	NA
China (Liu et al. [10], 2009)	5,030 (<24 mo)	38.0	17.9	13.7	1.4	NA
France* (Bellaiche et al. [11], 2018)	2,757 (0–6 mo)	21.8 single FGID	14.0	2.0	4.5	77.8
Africa† (Bellaiche et al. [12], 2020)	10,458 (0–12 mo)	NA	39.7	31.4	57.6	53.0
Italia (Iacono et al. [13], 2005)	2,879 (<6 mo)	54.9	23.1	17.6	20.5	NA
Review (Ferreira-Maia et al. [14], 2016)	45–9,660	27.1–38.0	<1.0–25.9	<1.0–31.0	NA	20.8

FGID: functional gastrointestinal disorder, NA: data not available.
*The subjects in the study performed in France were infants aged 0–6 months who presented for the first time with one or several minor digestive disorder(s) during consultation.
†Subjects in the study on African subjects were infants aged 0–12 months, presenting for the first time with functional gastrointestinal symptoms as the main complaint.
‡The prevalence from 13 studies.
§The prevalence from 8 studies.
‖The prevalence from 30 studies.
¶Expert consensus of worldwide prevalence.

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regurgitate during the first month of life, and 20% regurgitate more than four times per day. Another Chinese study that was conducted in Shanghai city revealed that 38% of 6–24 month old children presented with at least one FGID [10]. A higher prevalence was found in a study of French infants, which reported a prevalence of combined FGID of 77.8% among 2,757 infants [11]. An African study reported a prevalence of FGIDs in 10,812 infants of 57.6% for colic, 39.7% for regurgitation, and 31.4% for constipation [12]. In Italy the reported prevalence of FGID was 54.9% among 2,879 infants [13]. A systematic review of 13 studies from Europe (eight studies), America (three studies), and Asia (two studies) reported a prevalence of FGID of 27.1–38.0% [14].

The risk factors associated with FGIDs in infants (0–12 months) have been reported across various studies. Younger age (p=0.030) and formula feeding (p=0.045) are associated with any FGID [4]. The prevalence of colic increases with the maternal education level (Master's degree) and with low birth weight [6]. Being male, starting formula feeding during the first month of life, birth weight <2.5 kg, and living in a rural area increase the risk of infant regurgitation by 44% [6]. Formula-fed infants tend to have a higher prevalence of functional constipation than that observed in breastfed infants [15]. Breastfed infants had a lower risk to develop regurgitation. However, sex, ethnicity, prematurity, and birthweight are also not associated with FGIDs [8]. No significant differences have been observed in the length for age (LFA) and weight for length/height (WFL/H) between a group with and one without FGIDs, although the mean z-score of WFL was significantly lower in infants with regurgitation (p=0.001) [7].

Some FGIDs are extremely distressing for both infants and their parents [3]. FGIDs cause parental anxiety, resulting in repeated consultations with healthcare professionals and increased healthcare costs, which may be associated with a loss of income because the parents have to take time off from work [3,4].

The large variability in the reported prevalence of FGIDs in infants and the limited information available for Indonesia prompted us to conduct this study.

MATERIALS AND METHODS

We conducted a cross-sectional study from September 2018 to February 2020 in Jakarta and Yogyakarta, Indonesia. The recruitment was carried out through well-baby clinics, where parents/caregivers and infants came for a routine health visit. The study was approved by the Medical and Health Research Ethics Committee, Faculty of Medicine Universitas Gadjah Mada-DR. Sardjito General Hospital with reference number KE/FK/0480/EC/2018, dated 21 May 2018. The inclusion criteria were presumed healthy infants aged between 6 weeks and 4 months, term born (37–42 weeks of gestation), singleton, either breastfed (>75% of intake) or formula-fed (<25% of intake of mother's milk). The exclusion criteria were infants having a chronic or acute disease, necessitating medical follow-up, including cow's milk allergy. The infants cared for by parents or caregivers (defined as a person responsible for taking care of the infant ≥5 days per week), aged ≥18 years. Before participating in the study, the parents/caregivers signed the informed consent.

Anthropometric data, such as the infants' weight, length, and head circumference were measured during the health visit. The physician evaluated whether the infant fulfilled the adapted Rome IV criteria for the diagnosis of a FGID.

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This study used the Infant Gastrointestinal Symptom Questionnaire (IGSQ-13) [16] and adapted Rome IV criteria to define if an infant presented with one of the following FGIDs: constipation, regurgitation, and crying/colic. The IGSQ-13 is a validated test that was used to assess the individual GI symptoms or associated behavior. Constipation was considered when the infant passed a hard stool ≥2 times a week, and/or had difficulty passing bowel movements ≥4 times a week. Regurgitation was considered when the infant spat up milk >2 times a day. Crying was considered if infants suffered irritability, distress, or fussiness due to crying-related symptoms or if crying lasted >2 hours a day.

R software (R Development Core Team, 2013; http://www.r-project.org) was used for all statistical analyses [17]. The significance was set at two-sided alpha (α)=0.05. Descriptive analyses include calculating means, standard deviations, frequencies, and percentages. The potential predictive value of the predictors was explored using univariate logistic regression analyses and Least Absolute Shrinkage and Selection Operator (LASSO) variable selection methods. LASSO avoids issues related to multiple testing, reduces predetermined assumptions in the variable selection phase, and addresses multicollinearity problems from highly correlated covariates when fitting statistical models [18]. Ten-fold cross-validations determined the value of the tuning parameter λ in LASSO. The predictors involved in the selection process are presented in the **Appendix 1**. The final logistic model included predictors with non-zero coefficients in the fitted LASSO model or significant predictors determined by univariable models.

RESULTS

Sample characteristics

The information of 433 infants (mean age: 77.7 days) was collected and analyzed. However, the data of only 419 subjects could be included in the multivariate analysis due to incomplete data. Detailed socio-demographic and anthropometric data of the infants are presented in **Table 2**. Approximately 60% of the infants were born naturally. The average age of mothers and fathers was 29.5 and 32.8 years, respectively. The majority (80.8%) of fathers were working full-time or were self-employed, whereas 68.5% of the mothers stayed at home. More than one-third (36.2%) of the parents had a history of a GI disease.

Prevalence of FGIDs

The adapted Rome IV criteria were used to report the prevalence of three major FGIDs. Difficulty in bowel movements was reported by the parents in 12% of the infants. However, only a few infants (25/433; 5.5%) were categorized as having constipation (having difficulty in passing hard stools and bowel movements). More than 70% of the infants had ≥4 times/day flatulence. Approximately one in four infants (26.3%) regurgitated more than once per day. Less than 10% of the infants fulfilled the Rome IV criteria for colic during the previous two weeks. Less than one in five infants (16.8%) presented with crying/colic; however, only a few parents (6.7%) were unable to soothe their infants. The data are described in detail in **Table 3**. Combined FGIDs occurred in 8% of infants (**Table 3**); combined FGID were less frequent in younger infants (odds ratio [OR], 0.98; 95% confidence interval [CI], 0.95–1.00; p=0.045) (**Table 4**).

An analysis of the predictors predictive value for modeling the infants' probability of having FGIDs (constipation, regurgitation, or crying/colic) was conducted using univariate logistic

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Table 2. Demographics of the infants and parents

Characteristics	Value (n=433)
Age of infants (d)	77.7±21.5
Gestational age (wk)	38.7±1.3
Sex	
Female	206 (47.5)
Male	227 (52.4)
Parity including this one	1.96±1.1
Head circumference at birth (cm)*	33.2±1.4
Length at birth (cm)	48.4±1.8
Weight at birth (g)	3,115.5±449.0
Head circumference at visit (cm)	38.7±1.8
Length at visit (cm)	57.9±3.5
Weight at visit (g)	5,332.5±866.1
No of siblings	
0–12 mo	0.03±0.17
13–26 mo	0.16±0.37
Delivery mode	
Cesarean	174 (40.2)
Vaginal	259 (59.8)
Feeding mode	
Breastfed	120 (27.7)
Formula fed	313 (72.3)
Age of parents	
Mother	29.5±6.0
Father	32.8±7.0
Parent's history GI: Yes	157 (36.3)
Education level of father	
Low (<primary school)	49 (11.8)
Medium (high or professional school)	309 (71.4)
High (college+)	73 (16.8)
Education level of mother	
Low (<primary school)	51 (11.7)
Medium (high or professional school)	297 (68.7)
High (college+)	85 (19.6)
Employment status of father	
Employed or self-employed (full time)	350 (80.8)
Employed or self-employed (part-time)	77 (17.7)
Unemployed/not working	3 (0.6)
Employment status of mother	
Employed or self-employed (full time)	80 (18.4)
Employed or self-employed (part-time)	55 (12.7)
Unemployed/not working	297 (68.5)

Values are presented as mean±standard deviation or number (%).
*Missing data 288.

regression and LASSO prior to multivariate analyses. Among the screened predictors, age and sex were associated with constipation. The length at birth and at a clinic visit, family history of GI problems, and delivery method were associated with regurgitation. Age, gestational age, number of siblings (0–12 months), delivery method, weight at visit, and family history of GI problems were predictive for crying/colic. Employment of the father was also found to be associated with constipation, regurgitation, and colic.

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Table 3. Prevalence of functional gastrointestinal symptoms

GI symptoms	Value (n=433)
Pass a hard stool (wk)	
0 times	408 (94.2)
1 time	9 (2.0)
2–3 times	11 (2.5)
4–6 times	2 (0.4)
7 or more times	3 (0.6)
Experienced difficulty when passing a bowel movement (wk)	
0 times	381 (87.9)
1 time	22 (5.0)
2–3 times	21 (4.8)
4–6 times	4 (0.9)
7 or more times	5 (1.1)
Milk comes out of the infant's mouth/regurgitation (d)	
0 times	211 (48.7)
1 time	108 (24.9)
2–3 times	82 (18.9)
4–6 times	22 (5.0)
7 or more times	10 (2.3)
The volume of milk that usually was regurgitated (each time)	
5 mL	119 (27.4)
15 mL	63 (14.5)
30 mL	21 (4.8)
Approximately half the feeding	0 (0.0)
More than half the feeding	0 (0.0)
Infants seem uncomfortable or fussy when milk comes out of their mouth	
Never	172 (39.7)
Seldom	13 (3.0)
Sometimes	29 (6.7)
Almost always	7 (1.6)
Always	1 (0.2)
Total of time that infants usually cry (d)	
Less than 10 min	269 (62.1)
10–30 min	123 (28.4)
30 min–1 h	28 (6.4)
1–2 h	10 (2.3)
2 or more h	3 (0.6)
Parents are unable to soothe their infants to stop their crying (wk)	
0 times	386 (89.1)
1 time	29 (6.7)
2–3	0 (0.0)
4–6 times	0 (0.0)
7 or more times	0 (0.0)
Infants were gassy (d)	
0 times	5 (1.1)
1 time	15 (3.4)
2–3 times	107 (24.7)
4–6 times	144 (33.2)
7 or more times	161 (37.1)
Colic in the past week	
Yes	38 (8.7)
No	395 (91.2)
Infants diagnosed with colic	
Yes	4 (0.9)
No	422 (97.4)
FGIDs symptom cluster	
Constipation	24 (5.5)
Regurgitation	114 (26.3)
Crying/colic	73 (16.8)
Combined	35 (8.0)

Values are presented as number (%).
GI: gastrointestinal, FGID: functional gastrointestinal disorder.

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Table 4. Multivariate logistic regression model for FGID symptom clusters

Predictors	Constipation (n=24)			Regurgitation (n=114)			Crying (n=73)			Combined FGID (n=35)		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Sex (male)	2.74	1.07–7.71	0.043*	1.10	0.68–1.80	0.694	0.86	0.48–1.52	0.608	1.31	0.61–2.84	0.485
Age of infants (d)	0.98	0.95–1.01	0.164	0.99	0.98–1.01	0.260	1.00	0.98–1.01	0.617	0.98	0.95–1.00	0.045*
Gestational age (wk)	1.06	0.76–1.47	0.718	1.02	0.85–1.21	0.850	0.89	0.72–1.09	0.266	0.77	0.57–1.02	0.082
Delivery method (caesarean)	2.44	0.94–7.31	0.084	0.65	0.41–1.04	0.070	0.66	0.38–1.14	0.138	0.79	0.38–1.65	0.519
Weight at visit (g)	1.14	0.51–2.52	0.753	1.75	1.16–2.65	0.008*	0.58	0.35–0.96	0.038*	1.03	0.53–1.95	0.932
Length at visit (cm)	0.95	0.81–1.13	0.575	0.83	0.76–0.91	<0.001*	1.04	0.93–1.18	0.472	0.99	0.85–1.16	0.900
Length at birth (cm)	0.74	0.55–0.99	0.042*	1.08	0.93–1.26	0.295	1.19	1.00–1.42	0.050*	1.12	0.89–1.43	0.348
Number of siblings (0–12 mo)	0.00	NA	0.989	0.36	0.05–1.58	0.224	1.63	0.31–6.62	0.520	0.72	0.03–4.89	0.773
History GI parents (no)	0.63	0.22–1.61	0.355	1.43	0.89–2.29	0.141	2.12	1.23–3.68	0.007*	1.92	0.92–4.02	0.082
Employment of father (low to high)	0.30	0.12–0.77	0.010*	0.65	0.38–1.12	0.116	0.62	0.34–1.16	0.127	0.58	0.27–1.36	0.188
Employment of mother (low to high)	0.51	0.21–0.99	0.073	1.12	0.83–1.50	0.439	1.25	0.87–1.79	0.216	1.15	1.15	1.15
Education of father (low to high)	0.83	0.47–1.45	0.507	0.83	0.61–1.12	0.219	0.83	0.57–1.19	0.308	0.66	0.41–1.06	0.095
Education of mother (low to high)	1.92	1.07–3.51	0.031*	1.19	0.88–1.61	0.250	0.89	0.62–1.28	0.548	1.24	0.77–1.99	0.375

FGID: functional gastrointestinal disorder, GI: gastrointestinal, OR: odds ratio, CI: confidence interval, NA: data not available.
Variables included in the multivariate analysis were prescreened using univariate logistic regression and the LASSO technique. Combined FGIDs is infants present more than one FGIDs.
*Significant $p<0.05$.

Association between FGIDs and socio-demographic characteristics

Selected predictors based on the fitted LASSO model or significant predictors determined via univariable models were included in multivariate analyses and are presented in **Table 4**. Based on the multivariate analysis, the determinants associated with constipation were the infants' sex, length at birth, father's employment, and higher education of the mother education. Girls had a higher risk for constipation than boys (OR, 2.74; 95% CI, 1.07–7.71; $p=0.043$). Infants with a higher length at birth had lesser odds of developing constipation (OR, 0.74; 95% CI, 0.55–0.99; $p=0.042$). A better employment status of fathers was associated with infant constipation (OR, 0.30; 95% CI, 0.12–0.77; $p=0.010$). A higher maternal education may increase the probability of infant constipation (OR, 1.92; 95% CI, 1.07–3.51; $p=0.031$). A antropometric condition associated with the risk of infant regurgitation is the length of infants at visit (OR, 0.83; 95% CI, 0.76–0.91; $p<0.001$). Infants with a higher weight had higher odds of developing regurgitation (OR, 1.75; 95% CI, 1.16–2.65; $p=0.008$). The predictors associated with crying-related symptoms were lower weight (OR, 0.58; 95% CI, 0.35–0.96; $p=0.038$), a positive history of GI disease in parents (OR, 2.12; 95% CI, 1.23–3.68; $p=0.007$), or higher length at birth (OR, 1.19; 95% CI, 1.00–1.42; $p=0.05$).

DISCUSSION

This study aimed to estimate the prevalence of FGIDs in infants under 4 months of age in Indonesia and to identify the predictive risk factors. The selected age is reported as the age with the highest prevalence of FGIDs. The prevalence of FGIDs was assessed by applying adapted Rome IV criteria and the IGSQ-13 questionnaire. The IGSQ-13 questionnaire has been validated in four studies conducted in three countries with three different languages (Philippines, United States, and China), and is an effective tool for assessing GI distress in infants in different cultures [16].

The prevalence of FGIDs based on the adapted ROME IV criteria was: regurgitation in 26.3%, crying/colic in 16.8%, and constipation in 5.5% of the infants. A study in Malaysia found that the most common FGID using Rome IV criteria was regurgitation was lower (10.5%) [8], while data from China in 2,604 children (0–4 years) reported a higher prevalence of

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30.9% in 2–3 month old infants [6]. According to another Chinese study applying Rome III criteria, 38% of 6–24 month old children presented with at least one FGID [10]. The reported prevalence of FGIDs in 10,812 African infants was higher: 57.6% for colic, 39.7% for regurgitation, and 31.4% for constipation [11]. The large reported variation in the prevalence of FGID may be caused by differences in the ethnicity, feeding habits, and cultures; however, it is likely to be caused by differences in the inclusion criteria.

In our study, 8.1% (35/433) of infants presented with more than one FGID. The simultaneous manifestation of more than one FGID may be attributable to their bases lying in the same pathophysiological mechanisms [11,12].

The factors that were statistically associated with constipation in the present study were: being a female (OR, 2.74; 95% CI, 1.07–7.71; p=0.043), length at birth (OR, 0.74; 95% CI, 0.55–0.99; p=0.042), employment status of the father (OR, 0.30; 95% CI, 0.12–0.77; p=0.010), and higher maternal education (OR, 1.92; 95% CI, 1.07–3.51; p=0.031). Although these findings were based on reproducible statistical exploratory process, the potential bias and randomness in selected population could limit the generalization of these results in broader population. Further prospective studies should evaluate whether these associations are repeatable and clinically relevant. Education and income are associated with better access to healthcare, offering an increased opportunity for the reporting of FGIDs. The employment status of fathers is assumed to be a proxy indicator for a family's better socioeconomic situation, which may decrease the risk of FGIDs for the infant through better caring practices and access to healthcare professionals. The study also noted that infants of mothers with higher education had a higher probability of constipation. According to Indonesian culture, mothers with higher education tend to go for work and spent more time outside home. Vandenplas et al. [19] noted that the parents of infants (especially working parents) with FGID are keen to find a quick and easy solution and will often opt for medication hoping for rapid relief from symptoms, while a cornerstone of the management of FGIDs in infants is parental reassurance, anticipatory guidance, and education on the natural evolution of FGIDs and their contributing factors.

A study in Asia found no association between the functional constipation and living areas, lifestyle factors, and stressful life events [6]. A natural birth significantly correlated with a lower risk of functional constipation (OR, 0.005; 95% CI, 0.001–0.17; p=0.003) [6].

The factors that correlated statistically with regurgitation in this study were the length (OR, 0.83; 95% CI, 0.76–0.91; p<0.001) and weight (OR, 1.75; 95% CI, 1.16–2.65; p=0.008) of the infant at data collection. However, these data are likely not clinically meaningful. A Chinese study revealed that being a male (OR, 1.38; 95% CI, 1.04–1.82; p=0.024), being exclusively breastfed between 1 and 4 months, formula-fed before one month of age (OR, 2.42; 95% CI, 1.46–3.99; p=0.001), birth weight <2.5 kg (adjusted [adj] OR, 3.47; adj 95% CI, 1.01–11.89; adj p<0.048), and staying in a rural area significantly increased the risk of infant regurgitation 44% (OR, 1.44; 95% CI, 1.08–1.93; p=0.014) [6]. Living in a rural area is associated with a lower awareness of feeding management and a different health/traditional beliefs, related to differences in access to healthcare [20]. A study comparing a group with to a group without FGIDs reported no significant differences in the LFA and WFL/H; however, the mean z-score of WFL was significantly lower in infants with regurgitation (p=0.001) [7].

Crying is a way by which infants communicate with parents/caregivers. Prolonged crying is a source of anxiety and distress for the parents. Prolonged crying without any obvious cause

can be classified as infant colic [21]. The predictors statistically associated with crying/colic in this study were the length at birth (OR, 1.19; 95% CI, 1.00–1.42; p=0.05), weight at visit (OR, 0.58; 95% CI, 0.35–0.96; p=0.038), and a history of GI disease in the parents (OR, 2.12; 95% CI, 1.23–3.68; p=0.007). A Chinese study reported that a higher maternal education level (Master's degree) significantly increased the risk for infant colic (OR, 3.39; 95% CI, 1.02–11.33; p=0.047) [6]. The other factors increasing the risk of colic include maternal age, educational background, smoking, alcohol, maternal stress and anxiety, poor feeding technique [22], lack of family support, and family stress [23]. Ineffective parental responses are a result of incorrect interpretation of the crying of the infant, which in turn results in an unhappy baby [23].

This study found no association between FGIDs and gestational age or feeding. Iacono et al. [13] identified low birth weight and low gestational age as the two risk factors most frequently associated with the onset of FGIDs. Feeding was not associated with a risk to develop FGIDs, except for constipation which was linked to a low prevalence of breastfeeding [13]. A study in Malaysia showed that breastfed infants were less likely to regurgitate even after adjusting for age, ethnicity, birthweight, gestation, and weaning age (adj OR, 0.25; 95% CI, 0.12–0.54; p<0.001) [8]. However, previous Indonesian data showed no differences in the regurgitation prevalence between formula-fed and breastfed infants [9]. A more rapid gastric emptying in breastfed infants might be associated with a lower risk of regurgitation [8]. The possible limitations of this study are the selected age range, limited to infants between 6 weeks and 4 months of age as well as the adapted Rome IV criteria used.

In conclusion, regurgitation, constipation, and crying/colic are common FGIDs in infants. Some socio-demographic factors are statistically associated with FGIDs. Further studies need to determine whether these findings are clinically relevant, and can be considered when evaluating the risk factors for FGIDs, and inform and reassure parents.

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Appendix 1. Predictors' predictive values based on univariate logistic regression and LASSO for predicting FGID

Predictors	Constipation	Regurgitation	Crying
Age (d)	†		*†
Sex	†		
Age of the mother (y)			
Age of the father (y)			
Gestational age (wk)			†
Parity, including this birth			
Head circumference at birth (cm)			
Length at birth (cm)		†	
Weight at birth (g)			
Head circumference at visit (cm)			
Length at visit (cm)		*†	
Weight at visit (g)			*†
Number siblings between 13–36 mo			
Number siblings between 0–12 mo			†
Family history of gastrointestinal disease in the parents		†	*†
Delivery method		†	†
Feeding regimen			
Highest level of education of the father			
Highest level of education of the mother			
Employment of the father	*†	†	*
Employment of the mother			

LASSO: Least Absolute Shrinkage and Selection Operator, FGID: functional gastrointestinal disorder.
*For significant predictor using univariate analyses.
†For high predictive value predictor using LASSO.

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