CEP Clin Exp Pediatr Vol. 68, No. 8, 587–593, 2025
https://doi.org/10.3345/cep.2024.01795

Original article

# Somatic symptom severity during acute illnesses among children with functional gastrointestinal disorders

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**Background:** Functional gastrointestinal disorders (FGIDs) are associated with various gastrointestinal (GI) and non-GI symptoms, risk factors for which commonly include psychosocial and physical stresses.

**Purpose:** This study aimed to compare somatic symptom severity between children with FGIDs and healthy controls during acute illnesses.

**Methods:** This was a prospective descriptive cross-sectional study whose inclusion criterion was age 4–18 years. Children were classified into FGID and control groups using the Rome IV diagnostic criteria. Somatic symptom severity was estimated using a visual analogue scale (VAS) and the Children's Somatic Symptoms Inventory-24 (CSSI-24) questionnaire and compared between groups.

**Results:** Ninety-three children, including 40 with FGIDs (43%), were enrolled. The FGID group had statistically significantly higher VAS scores for abdominal pain than controls (2.93±3.68 vs. 0.72±2.08, $P$<0.001). However, no significant intergroup differences were noted in VAS scores for nausea ($P$=0.493) or headache ($P$=0.311). For somatization symptoms, the CSSI-24 total (20.58±18.32 vs. 7.06±10.49, P<0.001), GI symptom (9.60±7.48 vs. 2.43±3.39, $P$≤0.001) and non-GI symptom (10.98±11.67 vs. 4.62±7.88, $P$< 0.001) scores were significantly higher for the FGID versus control groups, respectively.

**Conclusion:** Children with FGIDs exhibited more significant somatic symptoms than controls during acute illnesses. GI and non-GI manifestations were significantly more common in children with FGIDs.

**Key words:** Children; Functional gastrointestinal disorders; Somatic symptoms

## Key message

Functional gastrointestinal disorders (FGIDs) are associated with various somatic symptoms measured using a visual analogue scale and the Children's Somatic Symptoms Inventory-24 questionnaire. Children with FGIDs exhibited more significant somatic symptoms than controls during acute illnesses. Gastrointestinal (GI) and non-GI manifestations are significantly more common in children with FGIDs.

## Introduction

Functional gastrointestinal disorders (FGIDs) are common gastrointestinal problems among children and adolescents. This condition is associated with various gastrointestinal (GI) symptoms such as abdominal pain, bloating, nausea, vomiting and abnormal defecation. Moreover, non-GI symptoms are also common manifestations, which include headache, visual change, photophobia, numbness as well as pallor.[1] Both psychosocial and physical stress are common risk factors to elicit these symptoms.[2] The diagnosis of FGIDs is made followed the Rome IV classification, which was classified in neonate/toddler and child/adolescent periods.[3,4] The prevalence of this problem varies and depends on the age group, region, socioeconomic status and genetic predisposition. The prevalence rates of FGIDs among children and adolescents was reported to range between 10% and 29%. Irritable bowel syndrome and functional constipation were common diagnoses.[5] Furthermore, the prevalence of FGIDs was higher at 27% to 38% among infants and toddlers. Of these, infant regurgitation and functional constipation were the common causes for this age group.[6] Complications and consequences of FGIDs include important factors and interfere with a child's activities, namely, poor quality of life,[7] anxiety and depression,[8] increasing healthcare cost,[9] sleep disorders[10] as well as disturbance of school function.[11]

Children with FGIDs may exhibit various extragastroin-

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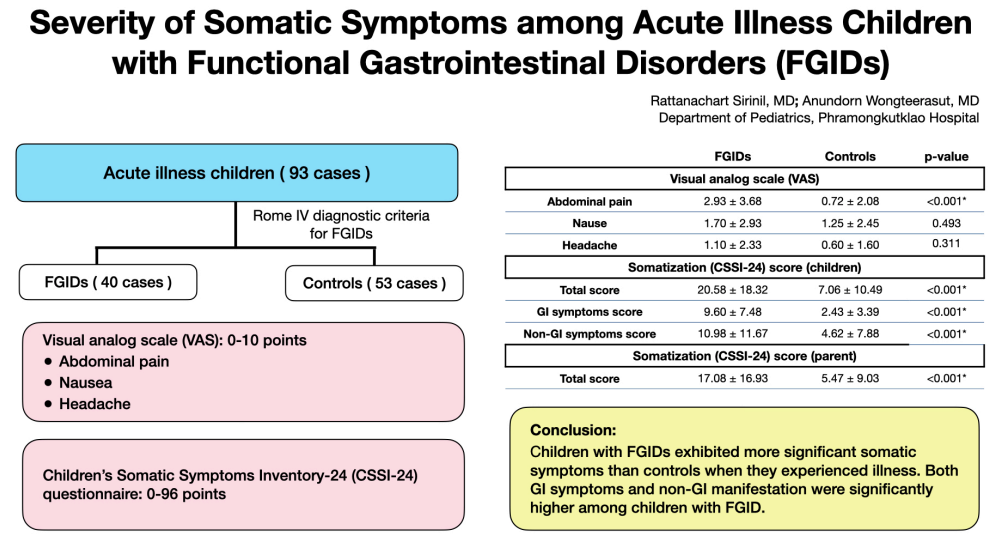
Received: 29 November 2024, Revised: 28 January 2025, Accepted: 22 February 2025




**Graphical abstract**

testinal somatic complaints such as headache, muscle pain, faintness, dizziness, difficulty breathing, numbness, weakness, palpitation and blurred vision.[12] A related observational study reported a significant rise in the prevalence of headaches among adolescents with functional dyspepsia.[13] Saps et al.[14] reported a consequence of FGIDs with acute gastroenteritis in emergency room settings and showed children with FGIDs exhibited a more significant severity of various somatic symptoms than controls. The severity of somatic symptoms can be evaluated among children with different methods such as the visual analogue scale (VAS).[15] Children's Somatic Symptoms Inventory-24 (CSSI-24) questionnaire[16,17] and 8-item Somatic Symptom Scale.[18]

The purpose of this study was to compare the severity of somatic symptoms among acute illness children with FGIDs and controls. Additionally, we want to identify common somatic symptoms among children with FGIDs including GI and non-GI symptoms and compare the consequences of illness in both groups.

## Methods

We conducted a prospective, descriptive cross-sectional study. The inclusion criteria comprised children, aged 4 to 18 years old, attending the Pediatric Department, Phramongkutklao Hospital between October 2021 and September 2022. Acute illness was defined as less than 14-day duration. The exclusion criteria consisted of chronic illnesses such as GI disorders, cardiovascular diseases, neurological conditions, malignancy, chronic kidney diseases, previous major abdominal surgery or abdominal surgical conditions, developmental delay as well as psychiatric disorders. The information, objective and consent of the study were completed by the assigned physician before enrollment. This study was conducted following the principles of the Helsinki Declaration as well as approved by the ethics committee of Phramongkutklao Hospital and College of Medicine with IRB number 720/2564 (R051Q_64) since June 2021.

### 1. Data collection

Basic information and demographic information were gathered from medical records. The data included relevant demographics, final diagnoses and the duration of illness.

### 2. Classification of children

Participants were divided in FGIDs and control groups using the validated Thai-version, standard Rome IV questionnaire for children/adolescents with FGIDs.[19,20] The questionnaires were compatible with 4- to less than 10-year-old children with parent-report forms and 10- to 18-year-old with children's self-report forms. This criterion was applied to determine the diagnosis of FGIDs, Moreover, we can classify the subtypes of FGIDs, including functional abdominal pain disorders (functional dyspepsia, irritable bowel syndrome, abdominal migraine and functional abdominal pain-not otherwise specified), functional defecation disorders (functional constipation and nonretentive fecal incontinence) as well as functional nausea and vomiting disorders (cyclic vomiting syndrome, functional nausea, functional vomiting, rumination syndrome and aerophagia). After that, clinical data and the consequences of illness were compared between the groups.

### 3. Data collection

On the first day, the severity of somatic symptoms (abdominal pain, nausea/vomiting, and headache) was col-

lected using VAS. The scale was a 10-cm line, the markings were plotted at zero (no symptoms) and 10 cm (most severe symptoms). To collect the score, children marked a single point or mark in the 10-cm line corresponding to the severity of each symptom. We measured the distance from zero point and converted it to a VAS score ranging from 0 to 10 points.

The CSSI-24 questionnaire for children was gathered to assess the severity of somatic symptoms in the past 2 weeks. The 24 items incorporated 5-point Likert scale from 0 (not at all) to 4 (a whole lot). Higher scores indicate greater perceived severity of somatic complaints. Total scores are the summation of items and ranging from 0 to 96. In parallel, a parent-report CSSI-24 form was used to collect the intensity of their child's somatic symptoms. Moreover, we classified different somatic symptoms into GI score (8 items), non-GI score (16 items), pain-related symptoms (7 items) cardiopulmonary score (2 items) and neurological symptoms (6 items). Children who are incapable to read the questionnaire on their own can listen to the interviewer read the items to them. Besides, during the VAS and CSSI-24 assessments, the data interviewers were unaware of the patients' allocation in the control or FGID groups.

Postillness clinical consequences were collected by phone to children or caregivers on day 14 after enrollment. The data were prevalence of diarrhea, nausea, vomiting, abdominal pain and headache. Prolonged symptoms were classified when children still presented these symptoms (14 days or more). Consequences of illness, included absence from school, loss of parental workday and unscheduled hospital visit were recorded. These data were analyzed and compared between groups.

### 4. Statistical analysis

The number of participants needed were calculated from the study of Devanarayana et al.[21] The difference in somatization score between children with functional abdominal pain and controls was 15.2±11.1 versus 8.4±8.8. The number of participants needed for our study totaled 39 children in each group. Continuous data were analyzed using the Student *t* test and categorized data were compared using chi-square or Fisher exact test. A *P* value <0.05 was considered significant. Data were collected and analyzed using IBM SPSS Statistics ver. 22.0 (IBM Co., USA).

## Results

Demographic and basic information of children in this cohort is displayed in Table 1. Eighty-eight (94.6%) of the total 93 children were inpatients. No statistical significance was noted in mean age (10.30±4.87 vs. 8.57±4.37, *P*=0.075), distribution of age category, percent weight for height, body mass index and the final diagnosis of children between children with FGIDs versus controls. The most common diagnosis was acute gastroenteritis which was 32 cases (34.4%), followed by acute lower respiratory tract infection (13.9%) and COVID-19 infection (12.9%). Acute and recurrent abdominal pain accounted for 6 cases (6.5%). FGIDs were diagnosed in 40 of 93 children (43%). A significantly higher number of females among children with FGIDs than controls (60% vs. 37.7%, *P*=0.033). The common subtype of FGIDs from this cohort was functional constipation, totaling 60% of cases, followed by 32.5% of functional dyspepsia, 15% of irritable bowel syndrome, and 10% of abdominal migraine. Functional abdominal pain-not otherwise specified, rumination syndrome, aerophagia and functional vomiting were identified, one case in each category. Table 2 reveals the subtypes of 40 children with FGIDs in this cohort.

Severities of abdominal pain, nausea and headache from VAS among children with FGIDs and controls were compared. The FGIDs group had statistically significantly higher VAS scores for abdominal pain than controls (2.93±3.68 vs. 0.72±2.08, *P*<0.001). However, no significant differences were observed in VAS for nausea (*P*=0.493) and headache (*P*=0.311) between groups. For somatization

**Table 1. Demographic data of patients enrolled in the study at Department of Pediatrics, Phramongkutklao Hospital, Bangkok, Thailand**

| Variable | Functional GI disorders (n=40) | Controls (n=53) | *P* value |
|---|---|---|---|
| Age (yr) | 10.30±4.87 | 8.57±4.37 | 0.075 |
| Distribution by age category | | | 0.098 |
| 4–9 Years | 18 (45.0) | 33 (62.3) | |
| 10–18 Years | 22 (55.0) | 20 (37.7) | |
| Female sex | 24 (60.0) | 20 (37.7) | **0.033*** |
| % Weight for height | 109.82±22.25 | 113.58±26.22 | 0.524 |
| Body mass index (kg/m$^2$) | 19.23±4.78 | 19.58±5.78 | 0.76 |
| Hospitalization | 35 (87.5) | 53 (100) | - |
| Diagnosis | | | 0.320 |
| Acute gastroenteritis | 17 (42.5) | 15 (28.3) | |
| Acute lower respiratory tract infection (bronchitis, pneumonia) | 4 (10.0) | 9 (17.0) | |
| COVID-19 infection | 5 (12.5) | 7 (13.2) | |
| Acute febrile illness | 2 (5.0) | 6 (11.3) | |
| Acute/recurrent abdominal pain | 5 (12.5) | 1 (1.9) | |
| Genitourinary tract infection | - | 3 (5.7) | |
| Others[a)] | 7 (17.5) | 12 (22.6) | |

Values are presented as mean±standard deviation or number (%).
GI, gastrointestinal; MISC-C, multisystem inflammatory syndrome.
[a)]Others: acute rheumatic fever, leptospirosis, diabetic ketoacidosis, arrhythmia, febrile convulsion, sinusitis, acute pyomyositis, bone fracture, spine spondylosis, Multisystem Inflammatory Syndrome in Children (MIS-C), acute arthritis, dengue fever, drug overdose, acute asthmatic attack.
Boldface indicates a statistically significant difference with *P*<0.05.

symptoms, CSSI-24 in the FGIDs group was significantly higher in total score (20.58±18.32 vs. 7.06±10.49, *P*<0.001), GI symptom score (9.60±7.48 vs. 2.43±3.39, P≤0.001), non-GI symptoms score (10.98±11.67 vs. 4.62±7.88, *P*<0.001), pain-related score (5.75±5.85 vs. 2.04±3.10, *P*=0.004), cardiopulmonary score (1.23±1.39 vs. 0.57±1.18, *P*=0.018) as well as neurological score (5.38±5.00 vs. 2.38±3.53, *P*=0.002).

Additionally, parental CSSI-24 scores were also significantly higher in total score (17.08±16.93 vs. 5.47±9.03, *P*< 0.001), GI symptom score (8.53±7.14 vs. 2.45±3.92, *P*<0.001), non-GI symptoms score (8.55±10.54 vs. 3.04 ±5.65, *P*<0.001), pain-related score (4.63±5.07 vs. 1.42±2.29, *P*<0.001), cardiopulmonary score (0.9±1.19 vs. 0.38±1.00, *P*=0.028), and neurological score (4.4±5.16 vs. 1.75±2.75, *P*=0.005). Table 3 shows the group comparison of VAS and CSSI-24 from this cohort.

The consequences of illness were collected after 2 weeks of illness and compared between the FGIDs and control groups. Prevalence of persistent diarrhea (30.0 vs. 13.2%, *P*=0.47) and prolonged abdominal pain (42.5% vs. 9.4%, *P*<0.001) were significantly higher among children in the FGIDs group. However, no statistically significant difference was noted in the prevalence of persistent vomiting, nausea, or headache between groups. Children with FGIDs and controls showed no statistically different absence on school days (2 [2–3] days vs. 2 [1–5] days, P=0.738) or from parents/caregiver's workdays (3 [2–3] days vs. 3 [2–14] days, *P*=0.637). Moreover, the number of children revisiting hospitals was found in 2 cases of FGIDs and revisiting was found in the control group; however, this finding was not statistically significant. The details of the consequences of illness are displayed in Table 4.

**Table 2. Functional gastrointestinal disorder subtypes in study cohort (N=40)**

| Subtypes | No. of cases (%) |
|---|---|
| Functional constipation | 24 (60.0) |
| Functional dyspepsia (postprandial distress syndrome 11 cases, epigastric pain syndrome 2 cases) | 13 (32.5) |
| Irritable bowel syndrome | 6 (15.0) |
| Abdominal migraine | 4 (10.0) |
| Functional abdominal pain-not otherwise specified | 1 (2.5) |
| Adolescent rumination syndrome | 1 (2.5) |
| Aerophagia | 1 (2.5) |
| Functional vomiting | 1 (2.5) |

**Table 4. Consequences at 14-day postillness of children with functional gastrointestinal disorders versus controls**

| Variable | Functional GI disorder (n=40) | Controls (n=53) | *P* value |
|---|---|---|---|
| Diarrhea | 12 (30.0) | 7 (13.2) | **0.047** |
| Vomit | 3 (7.5) | 3 (5.7) | 1.000 |
| Nausea | 10 (25.0) | 7 (13.2) | 0.145 |
| Abdominal pain | 17 (42.5) | 5 (9.4) | **<0.001** |
| Headache | 4 (10.0) | 2 (3.8) | 0.397 |
| School absenteeism (day) | 2 (2–3) | 2 (1–5) | 0.738 |
| Work absenteeism of parents/ caregivers (day) | 3 (2–3) | 3 (2–14) | 0.637 |
| Revisit | 2 (5.0) | 0 (0) | 0.182 |

Values are presented as number (%) or median (interquartile range).
GI, gastrointestinal.
Boldface indicates a statistically significant difference with *P*<0.05.

**Table 3. Visual analogue scale (VAS) and childhood somatic symptom score (CSSI-24) of children with functional gastrointestinal disorders versus controls**

| Variable | Functional GI disorder (n=40) | | Controls (n=53) | | *P* value |
|---|---|---|---|---|---|
| VAS score | | | | | |
| Abdominal pain | 0 (0–6.25) | 2.93±3.68 | 0 (0–0) | 0.72±2.08 | **<0.001** |
| Nausea | 0 (0–3.25) | 1.70±2.93 | 0 (0–0) | 1.25±2.45 | 0.493 |
| Headache | 0 (0–0.25) | 1.10±2.33 | 0 (0–0) | 0.60±1.60 | 0.311 |
| Somatization (CSSI-24) score (children) | | | | | |
| Total score | 13.00 (8.00–23.75) | 20.58±18.32 | 4 (0–11) | 7.06±10.49 | **<0.001** |
| Gastrointestinal symptoms score | 7.50 (4.00–13.00) | 9.60±7.48 | 1 (0–4) | 2.43±3.39 | **<0.001** |
| Nongastrointestinal symptoms score | 6.00 (3.00–14.25) | 10.98±11.67 | 2 (0–7) | 4.62±7.88 | **<0.001** |
| Pain-related score | 4.00 (2.00–6.00) | 5.75±5.85 | 1 (0–3) | 2.04±3.10 | **0.004** |
| Cardiopulmonary score | 1.00 (0–2.00) | 1.23±1.39 | 0 (0–1) | 0.57±1.18 | **0.018** |
| Neurological score | 4.00 (2.00–6.00) | 5.38±5.00 | 1 (0–3) | 2.38±3.53 | **0.002** |
| Somatization (CSSI-24) score (parents or caregivers) | | | | | |
| Total score | 9.00 (6.75–19.50) | 17.08±16.93 | 3 (0–7) | 5.47±9.03 | **<0.001** |
| Gastrointestinal symptoms score | 6.00 (4.00–11.25) | 8.53±7.14 | 1 (0–4) | 2.45±3.92 | **<0.001** |
| Nongastrointestinal symptoms score | 5.00 (2.00–9.25) | 8.55±10.54 | 1 (0–4) | 3.04 ±5.65 | **<0.001** |
| Pain-related score | 3.00 (1.75–5.00) | 4.63±5.07 | 1 (0–2) | 1.42±2.29 | **<0.001** |
| Cardiopulmonary score | 0.50 (0–1.25) | 0.9±1.19 | 0 (0–0) | 0.38±1.00 | **0.028** |
| Neurological score | 2.50 (1.00–6.00) | 4.4±5.16 | 1 (0–3) | 1.75±2.75 | **0.005** |

Values are presented as median (interquartile range) or mean±standard deviation.
GI, gastrointestinal; CSSI-24, Childhood Somatic Symptoms Inventory-24.
Boldface indicates a statistically significant difference with *P*<0.05.

## Discussion

This study is the first report of various somatic symptoms among Thai children with FGIDs and the effects of this condition among children classified using the Rome IV questionnaire. A prevalence of FGIDs from this cohort was identified by 43%, despite some of the children receiving hospital care with no complaints of GI symptoms. For the prevalence of FGIDs, our findings were higher than that of the systematic review of Velasco-Benítez CA et al. reporting the prevalence at 22% among toddlers and neonates.[22] A lower prevalence of the pool prevalence in a meta-analysis of older children and adolescents, reporting 13.5%.[23] The main reason for the difference in our data was possibly due to different conditions, races and lower number of children included in our cohort. Furthermore, children in the FGIDs group were predominantly female at 60% in this study. This finding could be distinguished from that of a study in the United States reporting an equal prevalence between males and females.[24] However, females were at risk of developing FGIDs in a study by Bouzios et al.[25] and meta-analytic study among children and adults.[26]

We identified a significantly higher severity of somatic symptoms including GI and non-GI symptoms with standard methods, namely, VAS and CSSI-24 scores. Our outcomes were also compatible with a study by Dengler-Crish et al.,[12] which is a prospective clinic-based study, that identified significantly higher GI and non-GI somatic symptoms among children meeting the diagnosis criteria of pediatric FGIDs classified by the Rome III questionnaire and controls at initial evaluation. Non-GI somatic symptoms were associated with FGIDs in a long-term follow-up. A high score of non-GI somatic symptoms at the initial pediatric evaluation was linked to a higher chance of FGIDs in adolescence and young adulthood. A meta-analysis of childhood FGIDs also revealed a relationship between somatic symptoms, namely, headache, extragastrointestinal pain, fatigue, fibromyalgia and pain-related disorders.[26] The FGIDs group in this study had more patients with acute gastroenteritis and acute abdominal pain than the control group, which could be a contributing factor to the higher prevalence of GI symptoms. However, when non-GI somatic symptoms were monitored, they were significantly more severe in the FGIDs group.

Possible mechanisms of higher somatic symptoms among children with FGIDs were multifactorial and not truly identified. Moreover, the possible causes of these conditions included intrinsic and extrinsic conditions. For extrinsic conditions, related studies among children with acute gastroenteritis evaluated severity of somatic symptoms with CSSI-24 and classified them in functional abdominal pain disorders (FAPDs) and controls. The finding indicated children with FAPDs showed significantly more GI and non-GI somatic symptoms than normal children. It was expected that acute GI inflammation would exacerbate pain intensity among patient presenting visceral hyperalgesia or allodynia leading to increased reports of symptoms.[14] Intestinal microbial composition constitutes a possible cause of intestinal symptoms related to FGIDs, which was associated with a higher prevalence of GI complaints.[27]

Regarding intrinsic causes, Geisser et al.[28] reported a study of sensory perception among individuals with functional somatic disorders including fibromyalgia and chronic fatigue syndrome, which are caused by increased sensory amplification in many parts of the body. This finding might be demonstrated by an increase intensity of pain and somatic symptoms. Saps et al.[14] described the possible causes of higher somatic symptoms in pediatric FAPDs as abnormal coping skills, severity of anxiety and depression. The consequences were related to the quality of life among children with this condition. Another prospective study demonstrated evidence of brain structure alterations among patients with functional pain disorders, which was a significant decrease in the volume of gray matter density in cortical areas when compared with controls.[29]

For the follow-up data at 2 weeks, we identified a significantly higher prevalence of diarrhea and abdominal pain among children with FGIDs. This result was consistent with earlier research demonstrating the effects of FGIDs and caretakers. The consequences of FAPDs included impact on school attendance and psychosocial aspects of children the same as patients with inflammatory bowel disease.[11] This condition was one of the possible medical causes of childhood school absenteeism.[30] Furthermore, this functional condition also majorly impacted the quality of life among these children.[31,32]

For clinical application, the information from our study provides an awareness of higher GI and non-GI somatic symptoms among children with FGIDs. These symptoms represent possible causes of overinvestigations, improper management and overuse of healthcare providers. Moreover, this data informed the impact effects of somatic symptoms on the daily life among children. This study was the first to describe the comparison data of somatic symptoms including follow-up clinical and consequences after illness between FGIDs and controls among Thai children. Furthermore, we performed a prospective study using standard questionnaires (Rome IV and CSSI-24) to diagnose FGIDs and severity of somatic symptoms. Concerning limitation, this study enrolled the data from children with acute illness in inpatient and outpatient settings. However, we have a significantly higher number of

children attending inpatient care. The follow-up was made by phone, which can cause lower accuracy of data. These findings were collected from a single center that may differ in outcomes race, region and ethnicity.

In conclusion, children with FGIDs exhibited more significant somatic symptoms than controls when they were troubled with acute illness. Both GI and non-GI manifestations were significantly higher among children with FGIDs. Moreover, abdominal pain and diarrhea were significantly higher for the long-term consequence of this condition.

## Footnotes

Conflicts of interest: No potential conflict of interest relevant to this article was reported.

Funding: This study received funding from the Department of Pediatric Phramongkutklao Hospital.

Author contributions: RS and AW performed a conceptualization, data curation, formal analysis, methodology, project administration, writing-original draft and writing review & editing.

Acknowledgments: The authors thank the Department of Pediatrics, Phramongkutklao Hospital and Phramongkutklao College of Medicine for support of the study

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**How to cite this article:** Sirinil R, Wongteerasut A. Somatic symptom severity during acute illnesses among children with functional gastrointestinal disorders. Clin Exp Pediatr 2025;68:587-93.