doi.org/10.36721/PJPS/2026.40.16155.1

Factors associated with treatment response to laxative therapy in pediatric functional constipation: A real-world retrospective study

Feng He[1], Li Liu[2], Liyuan Quan[2] and Gaowei Ren[2]*

[1]Department of Anorectal Surgery, The First Hospital of Qinhuangdao, No. 258, Wenhua Road, Haigang District, Qinhuangdao 066000, Hebei Province, China

[2]Pediatrics Department, The First Hospital of Qinhuangdao, No. 258, Wenhua Road, Haigang District, Qinhuangdao 066000, Hebei Province, China

Abstract: **Background**: Laxatives are the mainstay for pediatric functional constipation (FC), yet response factors need more real-world research. **Objectives**: This study investigated factors associated with laxative treatment response in children with functional constipation. **Methods**: Retrospective data were screened from 103 pediatric FC patients receiving polyethylene glycol treatment (The First Hospital of Qinhuangdao, Feb 2023–Nov 2025). After exclusion, 100 cases were included and divided into the responder group (n=68) and the non-responder group (n=32). The primary outcome measures included the Pediatric Constipation Score (PCS), the Bristol Fecal Morphology Scale (BSFS) and defecation frequency. Secondary endpoints included the incidence of abdominal pain, incidence of bloating, average daily dietary fiber intake, average daily water intake and average daily physical activity. A logistic regression analysis was conducted to identify independent risk factors associated with treatment response. **Results**: The baseline clinical characteristics of both groups were well-balanced (all $P > 0.05$). Post-treatment evaluation showed that the PCS score in the responder group decreased more significantly compared to the non-responder group ($P<0.001$). Meanwhile, increases in bowel movement frequency and BSFS scores were more pronounced in the responder cohort (all $P<0.001$). Compared to the non-responder group, the responder group also had lower incidences of abdominal pain and distension (all $P<0.05$). In terms of lifestyle-related indicators, the responder group had significantly higher daily average dietary fiber intake, average daily water intake and average daily physical activity levels (all $P<0.001$). Results from logistic regression analysis indicated that high baseline PCS scores, elevated incidence of abdominal pain, insufficient dietary fiber intake, low daily water intake and inadequate physical activity emerged as independent risk factors for poor laxative response in pediatric FC patients (all $P<0.05$). **Conclusion**: Laxative response in pediatric FC is affected by several factors, such as severe constipation, poor diet, low activity and abdominal pain.

Keywords: Influencing factors; Pediatric functional constipation; Polyethylene glycol; Treatment response

Submitted on 26-01-2026 – Revised on 27-03-2026 – Accepted on 13-04-2026

Article in Press

INTRODUCTION

Functional constipation (FC) ranks among the most prevalent functional gastrointestinal disorders in childhood (Tran and Sintusek, 2023). In recent years, the global prevalence of pediatric FC has shown a fluctuating upward trend. Studies worldwide have reported a prevalence range of 0.7% to 29.6%, with a median of 12% (Wegh *et al.*, 2022a, Huang *et al.*, 2021). The prevalence of FC among Chinese children is equally concerning. Relevant surveys indicate that the prevalence has approached the global average and continues to rise annually, imposing a heavy care burden on affected families while significantly increasing the consumption of medical resources (Pan and Jiao, 2025).

Children's FC can cause local gastrointestinal discomfort and have multiple impacts on their physical and mental development as well as quality of life (Zhang *et al.*, 2022). Prolonged constipation may lead to rectal dilation and reduced sensation in children and may also result in complications such as anal fissures, hemorrhoids and anal papillitis. Some children may even experience urinary system issues, such as urinary incontinence and urinary tract infections, which can affect their normal growth and development (Huang *et al.*, 2023). From other perspectives, defecation pain and incontinence may trigger emotions such as low self-esteem and anxiety in children. For school-age children, these symptoms can particularly disrupt normal social interactions and school life and may even have adverse effects on parent-child relationships (Dong *et al.*, 2023). Therefore, the timely implementation of scientific and effective treatment measures is crucial for breaking the vicious cycle of disease, improving bowel function and protecting children's physical and mental health.

Currently, pediatric FC mainly follows the principle of combining basic treatment with medication. Basic treatment includes dietary adjustments, training in bowel habits and increased physical activity, while medication is a core approach to alleviating symptoms and restoring normal physiological functions of intestinal peristalsis and

**Corresponding author:* e-mail: HFengE1984@hotmail.com

defecation (Niu *et al.,* 2022). Laxatives are commonly used to treat childhood FC. Among them, polyethylene glycol has been recommended by pediatric gastroenterology societies in Europe and North America as a first-line treatment for pediatric FC due to its proven efficacy and high safety (Gong *et al.,* 2025). Clinical practice has shown that laxatives can help most children resolve fecal block, soften their stools and restore regular bowel movements. However, there are individual differences in treatment response. Some children cannot achieve satisfactory results even with standardized laxatives and only about half of them recover and stop using laxatives within 6 to 12 months (Gan *et al.,* 2022). The heterogeneity of this treatment response not only prolongs the duration of illness and increases suffering in children, but may also lead parents to question treatment options, reduce treatment adherence and thus affect long-term treatment outcomes.

Identifying factors associated with laxative responses in pediatric FC patients is a prerequisite and foundation for optimizing treatment strategies and achieving personalized therapy. In recent years, scholars both domestically and internationally have conducted preliminary explorations of this issue and identified various potential influencing factors (Liu *et al.,* 2025). Regarding disease-specific characteristics, some studies suggest that constipation severity may affect treatment outcomes. Children with severe constipation may have a poorer response to laxatives due to more severe intestinal movement disorders and severe impaired rectal sensory function (Shen *et al.,* 2024). Some clinical observations have found that children with obvious abdominal pain have relatively lower success rates in receiving laxative treatment; however, the causal relationship and underlying mechanisms between the two still require further verification (Xiao *et al.,* 2025).

Dietary fiber, hydration and physical activity are essential for normal intestinal function. Fiber softens stool by absorbing water and promotes motility via gut microbiota fermentation (Yang *et al.,* 2024). While low fiber intake is a recognized risk factor for constipation, its quantitative relationship with laxative response remains unclear. Adequate hydration prevents excessive colonic water absorption, though evidence linking water intake to laxative sensitivity is limited (West *et al.,* 2022). Physical activity enhances intestinal peristalsis, yet its independent effect on the laxative response remains to be studied (West *et al.,* 2022).

Against this background, this study employed a retrospective design to collect clinical data from pediatric FC patients receiving laxative treatment at our hospital. By comparing and analyzing baseline characteristics and treatment-related indicators between the responding and non-responding groups, we aim to identify key factors affecting laxative response and screen for independent risk factors. The results of this study are expected to provide a reference for clinicians in developing personalized treatment strategies and lay the foundation for subsequent prospective studies and mechanism exploration.

Study design

Clinical data of 103 pediatric FC patients who visited The First Hospital of Qinhuangdao and received polyethylene glycol treatment between February 2023 and November 2025 were screened. After exclusion based on exclusion criteria, 100 patients were enrolled. According to the medical records, the patients were divided into a responder group (68 cases) and a non-responder group (32 cases) based on their responses to polyethylene glycol. (Fig. 1)

Inclusion criteria

(1) Aged 1–14 years; (2) Meeting the diagnostic criteria for pediatric FC as specified in the Rome IV Diagnostic Criteria(Velasco-Benitez *et al.,* 2021); (3) Receiving osmotic laxative (polyethylene glycol) treatment for the first time, with no prior use of other drugs affecting intestinal function (e.g., probiotics, prokinetics, etc.); (4) Complete clinical data.

Exclusion criteria

(1) Patients with organic constipation; (2) Those complicated with severe diseases of important organs such as the heart, liver, kidneys, or nervous system (Zhao *et al.,* 2025); (3) Concurrent participation in other clinical studies.

Response criteria

The treatment response criteria in this study referred to those specified in the Expert Consensus on Integrated Traditional Chinese and Western Medicine Diagnosis and Treatment of Pediatric FC (2025 Edition) (Medicine, 2025).

Treatment response: Core constipation symptoms in children improved significantly after treatment, with all of the following criteria met simultaneously for 4 consecutive weeks, rather than being assessed only at a single 8-week time point.: (1) The pediatric constipation score (PCS) decreased by ≥50% compared with that before treatment; (2) The Bristol stool form scale (BSFS) score increased to grade 3–4 (i.e., stools were banana-shaped, soft and formed, consistent with normal stool characteristics); (3) Defecation frequency was ≥3 times per week, without discomfort such as straining during defecation or painful defecation.

Non-response to treatment: Failure to me*et al*l the above criteria, including insufficient symptom improvement, failure to maintain the criteria for 4 consecutive weeks, or aggravated symptoms.

Article in Press

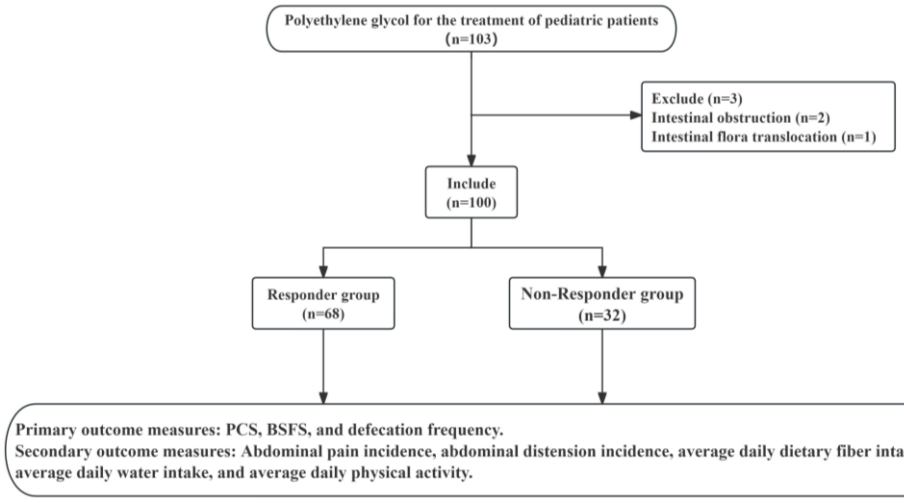


Fig. 1: Study flow chart
Note: 103 patients were initially screened in this study, after exclusion, 100 cases were included, with 68 patients in responder group and 32 patients in non-responder group. PCS: Pediatric Constipation Score; BSFS: Bristol Stool Form Scale.

Medication regimen

The medication regimen in this study was formulated in accordance with routine clinical diagnosis and treatment practices and the Expert Consensus on Integrated Traditional Chinese and Western Medicine Diagnosis and Treatment of Pediatric FC (2024 Edition)(Medicine, 2025). All children were treated with polyethylene glycol (H20080092, Maren Pharmaceutical Group Co., Ltd., Wuhan, Hubei, China). The initial dose was 0.5 g/kg·d for children aged 1–5 years and 0.3–0.5 g/kg·d for children aged 6–14 years. All doses were dissolved in warm water and taken orally on an empty stomach in the morning. The maximum daily dose of polyethylene glycol did not exceed 1 g/kg·d. All children received treatment for more than 8 weeks, with no switching to other types of laxatives during the treatment period.

Data collection

All baseline observational and clinical data were collected within 24 hours before the children's first visit and initiation of polyethylene glycol treatment. Outcome data of the observational indicators were collected at 8 weeks of treatment. Data were independently extracted by two uniformly trained researchers, followed by cross-checking upon completion of extraction.

Observation indicators

Primary observation indicators

(1) PCS(Ghaderi *et al.*, 2023): A standardized PCS was used for evaluation, with item-by-item scoring of dimensions including defecation frequency, stool characteristics, defecation straining, defecation pain, abdominal distension and fecal incontinence in children. The total score ranges from 0 to 30, with higher scores indicating more severe constipation. The scale adopted the version recommended by the Gastroenterology Professional Committee of the Pediatricians Branch of the Chinese Medical Doctor Association.

(2) BSFS Score(Abd El Azeem *et al.*, 2023): The child's guardian judged and recorded the stool characteristics after each defecation by referring to the standard BSFS atlas, which was then reviewed and confirmed by physicians. The scale classifies stools into 1–7 grades: low scores (1–2 points) indicate dry and hard stools, suggesting constipation; moderate scores (3–4 points) indicate normal stool characteristics and stable intestinal function; high scores (5–7 points) indicate loose and soft stools, suggesting excessive intestinal peristalsis.

(3) Defecation Frequency: The guardian recorded the daily number of defecations and the average value was taken as the daily defecation frequency[21].

Secondary observation indicators

(1) Abdominal Pain Incidence and Abdominal Distension Incidence: Abdominal pain incidence = (number of days with abdominal pain during treatment / total treatment days) × 100%(Gordon *et al.*, 2024); Abdominal distension incidence = (number of days with abdominal distension during treatment / total treatment days) × 100%(Vadlapudi *et al.*, 2025). Abdominal pain and distension symptoms were confirmed by the child's subjective description combined with the physician's physical examination, which included abdominal palpation.

(2) Daily Average Dietary Fiber Intake: A 24-hour dietary recall method was adopted. Under the guidance of a dietitian, the child's guardian continuously recorded the child's dietary intake, including the types and quantities of food. The daily dietary fiber intake was calculated using

Article in Press

"Application of Dietary Fiber in Healthy Children and Pediatric Gastrointestinal Diseases: A Practical Guide" (Salvatore *et al*., 2023) and the average value was taken as the daily dietary fiber intake.

(3) Daily Average Water Intake: Use a standardized measuring cup (Model: JB-250, Manufacturer: Shanghai Jiaben Medical Device Co., Ltd., Country of Origin: Shanghai, China). The guardian recorded daily water intake and calculated the average daily water intake (Mulhem *et al.*, 2022).

(4) Daily Average Physical Activity: Smart sports bracelets (Model: Mi Band 8, Manufacturer: Beijing Xiaomi Mobile Software Co., Ltd., Origin: Beijing, China) were used to monitor the children's daily activity. The total daily activity duration was recorded and the average value was taken as the daily average physical activity (Dias *et al.*, 2023a).

Ethical statement

This study has been reviewed and approved by the Medical Ethics Committee of The First Hospital of Qinhuangdao, with approval number 2019H037. The study design and implementation strictly adhered to the Declaration of Helsinki to fully protect the legitimate rights, interests and safety of the subjects.

Sample size calculation

As a retrospective study, no a priori sample size estimation was performed. The final sample size (68 cases in the responder group and 32 in the non-responder group) was determined by the number of patients who met enrollment criteria and had complete clinical data. A post hoc power analysis was performed using G*Power (version 3.1.9.7). Taking cues from previous studies (Tavassoli *et al*., 2021), Cohen's d was estimated to be 0.73 (defecation frequency before polyethylene glycol treatment for pediatric FC was 3.42 ± 1.80 times/d and 6.16 ± 1.33 times/d after treatment). Setting the two-tailed test level α at 0.05 and the type II error rate β at 0.10, the required sample sizes for the two groups were calculated as 31 cases (non-responder group) and 61 cases (responder group), respectively. To ensure the reliability of the study outcomes, the minimum detectable effect for the primary outcome indicator (defecation frequency) was additionally estimated at 0.97, which was smaller than the effect size observed in this study (0.983), indicating that the study had sufficiently high detection sensitivity for the target effect.

Statistical analysis

All data in this study were sorted and analyzed using SPSS 27.0 statistical software. Logistic regression analysis was used to adjust for confounding factors in the baseline data. The normality test (Kolmogorov-Smirnov test) and the homogeneity of variance test (Levene test) were first performed on the continuous data. Continuous data that were normally distributed and had homogeneous variance were expressed as mean ± standard deviation (mean±SD). Analysis of covariance was used for inter-group comparison and paired t-test was used for intra-group comparison. Continuous data that were not normally distributed were expressed as median (interquartile range) [M (Q1, Q3)]. Mann-Whitney U test was used for inter-group comparison and Wilcoxon rank-sum test was used for intra-group comparison. Categorical data were expressed as number (percentage) [n (%)] and inter-group comparison was performed using the chi-square test. Bonferroni correction was applied. Indicators with $P<0.05$ in the univariate analysis were included in the Logistic regression model to screen for independent risk factors affecting treatment response. Binary variables were coded as 1 = present/abnormal and 0 = absent/normal. An OR < 1 indicates that the presence of the factor is positively associated with poor treatment response. All statistical tests were two-tailed and a P value <0.05 was considered statistically significant.

RESULTS

Baseline data

Confounding factors were adjusted for using logistic regression. The results suggested that the baseline clinical data of the two groups were balanced and comparable, with no significant differences (all P>0.05), thereby eliminating the interference of baseline confounding factors in the subsequent comparative analysis of treatment effects (Table 1).

PCS

Results in table 2 showed that there was no significant difference in PCS scores between the two groups before polyethylene glycol treatment (P=0.195). After treatment, the scores of both groups were significantly lower than before treatment (all P<0.05) and the post-treatment score in the responder group was notably lower than that in the non-responder group (P<0.001). This indicates that polyethylene glycol treatment exerted a more pronounced effect in ameliorating constipation symptoms in children in the responder group.

BSFS

There was no statistically significant difference in BSFS scores between the two groups before treatment (P=0.869). After treatment, the scores of both groups were significantly higher than before treatment (all P<0.05) and the post-treatment score in the responder group was significantly higher than that in the non-responder group (P<0.001). This suggests that the improvement in stool characteristics was more pronounced in children in the responder group (Table 3).

Article in Press

Table 1: Baseline clinical data

Indicators	Responder group (n=68)	Non-responder group (n=32)	*P*	OR	95%CI for OR
Age (years, mean±SD)	6.90±1.04	7.08±0.65	0.394	1.222	0.77,1.94
Gender (n %)			0.917	1.046	0.448,2.442
Male	39 (57.4%)	18 (56.3%)			
Female	29 (42.6%)	14 (43.7%)			
BMI (kg/m^2, mean±SD)	15.65±0.64	15.78±0.58	0.336	1.404	0.703,2.804
Residence (n %)			0.413	1.425	0.610,3.332
City	42 (61.8%)	17 (53.1%)			
Urban area	26 (38.2%)	15 (46.9%)			
Constipation course (months, mean±SD)	8.74±1.10	8.95±0.77	0.327	1.241	0.806,1.909
PCS (scores, mean±SD)	18.22±1.36	18.58±1.09	0.195	1.256	0.89,1.772
BSFS (scores, mean±SD)	2.04±0.25	2.05±0.23	0.867	1.161	0.202,6.66
Defecation frequency (times/d, mean±SD)	0.78±0.10	0.77±0.11	0.777	0.554	0.009,32.8
Abdominal pain incidence (n %)	32 (47.1%)	18 (56.3%)	0.392	0.691	0.297,1.61
Abdominal distension incidence (n %)	28 (41.2%)	15 (46.9%)	0.592	1.261	0.541,2.937
Daily average dietary fiber intake (g/d, mean±SD)	8.56±2.39	8.54±2.39	0.969	0.996	0.834,1.19
Daily average water intake (mL, mean±SD)	500.21±11.85	499.97±11.66	0.924	0.998	0.963,1.035
Daily average physical activity (min/d, mean±SD)	39.57±2.80	39.03±2.42	0.345	0.926	0.79,1.086

Note: OR: Odds Ratio; 95%CI: 95% Confidence Interval; BMI: Body Mass Index; PCS: Pediatric Constipation Score; BSFS: Bristol Stool Form Scale.

Table 2: Comparison of PCS scores (mean±SD, scores).

Indicators	Time	Responder group (n=68)	Non-responder group (n=32)	*P*	Effect size (Cohen's d)	Bonferroni
PCS	Before treatment	18.22±1.36	18.58±1.09	0.195	0.280	0.390
	After treatment	7.41±0.65*	14.42±0.72*	<0.001	0.996	<0.001

Note: *P<0.05 vs. Before treatment.

Table 3: Comparison of BSFS scores (mean±SD, scores).

Indicators	Time	Responder group (n=68)	Non-responder group (n=32)	*P*	Effect size (Cohen's d)	Bonferroni
BSFS	Before treatment	2.04±0.25	2.05±0.23	0.869	0.036	1.000
	After treatment	3.13±0.23*	2.53±0.47*	<0.001	0.717	<0.001

Note: *P<0.05 vs. Before treatment.

Table 4: Comparison of defecation frequency (mean±SD, times/d)

Indicators	Time	Responder group (n=68)	Non-responder group (n=32)	*P*	Effect size (Cohen's d)	Bonferroni
Defecation frequency	Before treatment	0.78±0.10	0.77±0.11	0.779	0.060	1.000
	After treatment	1.54±0.20*	0.92±0.31*	<0.001	0.983	<0.001

Note: *P<0.05 vs. Before treatment.

Defecation frequency

There was no statistically significant difference in defecation frequency between the two groups before treatment (P=0.779). After treatment, the defecation frequency of both groups was significantly increased compared with pre-treatment levels (all P<0.05) and the post-treatment defecation frequency in the responder group was higher than that in the non-responder group (P<0.001) (Table 4). This indicates that polyethylene glycol treatment led to a greater improvement in defecation frequency in children in the responder group.

Abdominal pain incidence

There was no statistically significant difference in the incidence of abdominal pain between the two groups before treatment (47.1% vs. 56.3%, P=0.391). After treatment, the incidence of abdominal pain in the responder group was significantly reduced compared with before treatment (P<0.05), whereas no significant change was observed in the non-responder group (P>0.05). Additionally, the post-treatment incidence of abdominal pain in the responder group (10.3%) was lower than in the

Article in Press

non-responder group (46.9%) (P<0.001). These results indicate that the reduction in abdominal pain incidence was more pronounced in children in the responder group after treatment. (Table 5)

Abdominal distension incidence

See table 6. There was no statistically significant difference in the incidence of abdominal distension between the two groups before treatment (41.2% vs. 46.9%, P=0.591). After treatment, the incidence of abdominal distension in the responder group decreased to 11.8%, which was notably lower than the baseline level (P<0.05). The incidence of abdominal distension in the non-responder group was 37.5%, with no significant difference relative to baseline (P>0.05). Inter-group comparison revealed that the post-treatment incidence of abdominal distension in the responder group was significantly lower than in the non-responder group (P=0.003). The above analysis indicates that polyethylene glycol treatment achieved a superior effect in reducing the incidence of abdominal distension in children in the responder group.

Dietary fiber intake, water intake and physical activity

Results in table 7 showed that there were no statistically significant differences in daily average dietary fiber intake, daily average water intake and daily average physical activity across both groups before treatment (P=0.969, P=0.925, P=0.349). After treatment, all three indicators in both groups were significantly higher than before treatment (all P<0.05) and the levels of each indicator in the responder group were significantly higher than in the non-responder group (all P<0.001). This suggests that improvements in dietary fiber intake, water intake and physical activity in children in the responder group were far superior to those in the non-responder group after treatment.

Independent risk factors for poor treatment response

After adjusting for confounding variables in table 1, indicators with P<0.05 in tables 2–7 were included in the logistic regression model (Table 8). The results showed that elevated PCS (B=0.986, P<0.001, OR=2.681, 95%CI: 1.858–3.869), high abdominal pain incidence (B=-2.04, P<0.001, OR=0.13, 95%CI: 0.046–0.37), low daily average dietary fiber intake (B=-1.299, P<0.001, OR=0.273, 95%CI: 0.166–0.448), low daily average water intake (B=-0.025, P<0.001, OR=0.975, 95%CI: 0.967–0.984) and low daily average physical activity (B=-0.333, P=0.008, OR=0.717, 95%CI: 0.560–0.916) emerged as independent risk factors for poor treatment response. In addition, BSFS, defecation frequency and abdominal distension incidence had no significant independent impact on treatment response (all P > 0.05). Given moderate multicollinearity among lifestyle factors (VIF 2.85–3.42, r = 0.55–0.62), the above negative results may reflect a true absence of association or stem from reduced statistical efficiency or shared variance due to collinearity, rather than a definitive rejection of independence.

DISCUSSION

Pediatric FC is a common functional intestinal disorder in the pediatric digestive system and laxatives are first-line therapeutic agents; polyethylene glycol is widely used in clinical practice. This study conducted a real-world retrospective analysis to identify independent risk factors influencing laxative response in pediatric FC patients, using clinical data to provide more reliable references for clinical treatment.

The results of this study showed that after polyethylene glycol treatment, the reduction in PCS scores in the responder group was significantly greater than in the non-responder group, indicating a more pronounced improvement in overall constipation severity. The increases in defecation frequency and BSFS scores in the responder group were notably higher than those in the non-responder group, suggesting that children in the responder group achieved better improvements in defecation regularity and stool characteristics after treatment. For accompanying symptoms, the incidence of abdominal pain and distension in the responding group was significantly lower than in the non-responding group, indicating that children with good treatment responses also effectively alleviated intestinal discomfort. In addition, analysis of lifestyle-related indicators indicated that the average daily dietary fiber intake, average daily water intake and average daily physical activity in the responding group were significantly higher than those in the non-responding group. Further logistic regression analysis identified independent risk factors for laxative response in pediatric FC patients, including high constipation severity scores, a high incidence of abdominal pain, low dietary fiber intake, low daily water intake and low levels of physical activity. These results indicate that multiple factors, including disease severity, accompanying symptoms and lifestyle, are closely related to laxative responses and collectively influence treatment outcomes.

This study found that a higher PCS score may be an independent risk factor for poor laxative response in pediatric FC patients. A possible reason is that, in children with severe constipation, the intestines are in a prolonged state of fecal accumulation, which may trigger a chronic inflammatory response in the intestinal mucosa, suppress the contractile function of intestinal smooth muscle and thus reduce intestinal motility (Pan and Jiao, 2025).

Article in Press

Table 5: Comparison of abdominal pain incidence [n (%)]

Indicators	Time	Responder group (n=68)	Non-responder group (n=32)	*P*	Effect size (Phi)	Bonferroni
Abdominal pain incidence	Before treatment	32 (47.1%)	18 (56.3%)	0.391	0.086	0.782
	After treatment	7 (10.3%)*	15 (46.9%)	<0.001	0.412	<0.001

Note: *P<0.05 vs. Before treatment.

Table 6: Comparison of abdominal distension incidence [n (%)]

Indicators	Time	Responder group (n=68)	Non-responder group (n=32)	*P*	Effect size (Phi)	Bonferroni
Abdominal distension incidence	Before treatment	28 (41.2%)	15 (46.9%)	0.591	0.054	1.000
	After treatment	8 (11.8%)*	12 (37.5%)	0.003	0.300	0.006

Note: *P<0.05 vs. Before treatment.

Table 7: Comparison of dietary fiber intake, water intake and physical activity level (mean±SD)

Indicators	Time	Responder group (n=68)	Non-responder group (n=32)	*P*	Effect size (Cohen's d)	Bonferroni
Daily average dietary fiber intake (g/d)	Before treatment	8.56±2.39	8.54±2.39	0.969	0.008	1.000
	After treatment	18.34±0.71*	12.48±0.57*	<0.001	0.946	<0.001
Daily average water intake (mL)	Before treatment	500.21±11.85	499.97±11.66	0.925	0.020	1.000
	After treatment	1109.85±26.63*	845±26.40*	<0.001	0.957	<0.001
Daily average physical activity (min/d)	Before treatment	39.57±2.80	39.03±2.42	0.349	0.202	0.698
	After treatment	84.51±4.80*	52.56±2.49*	<0.001	0.928	<0.001

Note: *P<0.05 vs. Before treatment.

Table 8: Independent risk factors for poor treatment response

Indicators	B	*P*	OR	95%CI for OR	VIF	Tolerance
PCS	0.986	<0.001	2.681	1.858,3.869	1.15	0.870
BSFS	-0.291	0.432	0.747	0.362,1.544	1.42	0.704
Defecation frequency	-0.861	0.072	0.423	0.166,1.08	2.85	0.351
Abdominal pain incidence	-2.04	<0.001	0.13	0.046,0.37	1.23	0.813
Abdominal distension incidence	-0.751	0.108	0.472	0.189,1.18	1.31	0.763
Daily average dietary fiber intake	-1.299	<0.001	0.273	0.166,0.448	3.42	0.292
Daily average water intake	-0.025	<0.001	0.975	0.967,0.984	3.28	0.305
Daily average physical activity	-0.333	0.008	0.717	0.560,0.916	2.95	0.339
Hosmer-Lemeshow (*P*)				0.827		

In this case, even with laxative use, the intestinal tract's sensitivity to drugs may be reduced, making it difficult to promote effective intestinal peristalsis and fecal excretion. The high incidence of abdominal pain may be closely associated with poor laxative response, which may be related to intestinal spasm and visceral hypersensitivity (Kumar *et al.*, 2023). Abdominal pain in pediatric FC patients is mostly caused by fecal accumulation in the intestines, which leads to intestinal distension and further stimulates spasmodic contraction of intestinal smooth muscle. At the same time, long-term intestinal stimulation may cause visceral hypersensitivity in children, where even mild intestinal distension can trigger obvious abdominal pain (Ladi-Seyedian *et al.*, 2023). This state of intestinal spasm and hypersensitivity may interfere with the regulatory effect of laxatives on intestinal motility, thereby reducing the intestinal tract's responsiveness to laxatives. Insufficient dietary fiber intake may be an important factor in poor laxative response. Dietary fiber is regarded as the "scavenger" of the intestines and its main mechanisms of action may include increasing fecal volume, stimulating intestinal mucosal receptors and thereby promoting intestinal peristalsis (Dias *et al.*, 2023b) and absorbing water in the intestines to soften feces for easier excretion. In pediatric FC patients, if dietary fiber intake is insufficient in the daily diet, even with laxative use, it may be difficult to form feces of sufficient volume to stimulate intestinal peristalsis,

Article in Press

resulting in an inadequate laxative effect. On the contrary, adequate dietary fiber may have a synergistic effect with laxatives, enhancing intestinal motility and thus improving treatment outcomes (Hojsak *et al.*, 2022). In addition, dietary fiber may also regulate the balance of intestinal flora, promote the growth and reproduction of beneficial bacteria, improve the intestinal microecological environment and thereby facilitate the recovery of intestinal function (Kwiatkowska and Krogulska, 2021). Low daily water intake may be closely associated with poor laxative response and this result may complement the mechanism of action of dietary fiber (Ladi-Seyedian *et al.*, 2023).

Both osmotic laxatives and bulk-forming laxatives likely require sufficient water to exert their effects. Polyethylene glycol may create a hyperosmolar environment in the intestines, drawing water from the body to soften feces. If a child's daily water intake is insufficient, leading to intestinal water depletion, laxatives may not fully soften feces or increase fecal volume, making it difficult to achieve ideal treatment outcomes (Kruger Howard and Morgan, 2024). At the same time, insufficient water in the intestine itself may be an important cause of constipation, which may further aggravate fecal dryness and reduce treatment response. Low physical activity may be another independent risk factor affecting laxative response. Appropriate physical activity may promote intestinal peristalsis by mechanically stimulating the intestines. During the growth and development stage, insufficient physical activity in children may lead to weakened intestinal motility, resulting in prolonged intestinal retention, excessive water absorption and subsequent fecal dryness and aggravated constipation (Adil *et al.*, 2024). Even with laxative use, insufficient intestinal motility may affect drug transport and action exertion, thereby reducing treatment effects. On the contrary, adequate physical activity may enhance the contractile function of intestinal smooth muscle, improve intestinal motility and have a synergistic effect with laxatives to better improve defecation symptoms.

A meta-analysis confirmed that insufficient physical activity leads to weakened intestinal motility and reduces the regulatory effect of laxatives on intestinal peristalsis (Wegh *et al.*, 2022 b), further supporting the conclusions of this study. Among the studies incorporating 9 randomized controlled trials (Rajindrajith *et al.*, 2024), it is clearly stated that adequate dietary fiber intake, proper hydration and regular physical activity are fundamental prerequisites for laxatives to achieve optimal therapeutic efficacy. An article on the evaluation and treatment of pediatric FC (Mulhem *et al.*, 2022) stated that increasing dietary fiber and water intake has no additional benefits for the treatment of constipation, which is similar to the result of this study that low dietary fiber intake and low daily water intake affect laxative response in pediatric FC patients.

This study adopted a real-world retrospective design, including clinical data of 100 pediatric FC patients. The sample size is relatively large and the study subjects were derived from the actual clinical population. The results are more in line with clinical practice and have high external validity and clinical reference value. The research indicators are comprehensive, covering not only core clinical indicators such as the severity of constipation, frequency of bowel movements and defecation characteristics, but also accompanying symptoms such as abdominal pain and distension, as well as lifestyle indicators such as dietary fiber intake, water intake and physical activity, enabling a comprehensive analysis of factors affecting treatment response.

Study limitations

The retrospective study design itself has inherent flaws that may affect the accuracy of the study results. This is a single-center study and all enrolled children were from the same hospital, which may introduce selection bias and limit the generalizability of the study results. No stratified analysis was performed by type or dosage of laxatives. Different types and dosages of laxatives may have different effects on treatment response and the role of this factor cannot be clarified. Developmental characteristics differ across age groups and age-stratified analysis was not performed. The observation time was short, so it was impossible to assess the long-term treatment response in children or the long-term impact of related factors, resulting in limited timeliness of the study results. As this was a retrospective study, no a priori sample size calculation was performed. However, the study was underpowered to detect smaller, but clinically meaningful, effects in the secondary outcomes. Therefore, non-significant results for variables such as BSFS and abdominal distension incidence should be interpreted with caution. Some children in the non-responder group may have achieved partial clinical improvement and their risk factors may differ from those with no response at all. This could lead the logistic regression model to underestimate the true effect or mask predictors specific to partial responders. Dietary and activity-related indicators may be subject to recall bias.

In the future, multicenter, prospective cohort studies need to be conducted to expand sample sizes, include children from hospitals across different regions and levels, reduce selection bias and improve the generalizability of study results. Long-term follow-up of study subjects should be performed to assess the long-term treatment response in children, analyze the long-term impact of related factors and provide references for the formulation of long-term clinical treatment strategies. Stratified analysis of laxative type and dosage should be conducted to clarify the impact of different types and dosages on treatment response, as well as the interactions between related factors and laxative type and dosage. Future prospective studies

Article in Press

should establish standardized compliance assessment and follow-up mechanisms. Future studies should determine sample size based on a priori power analysis. Future studies may integrate studies with different response definitions through dose–response analysis to verify the robustness of the findings from the present study.

CONCLUSION

Multiple factors jointly influence pediatric FC patients' response to laxative treatment. Among them, high constipation severity, high incidence of abdominal pain, insufficient dietary fiber intake, low daily water intake and insufficient physical activity are important independent risk factors for a poor response to polyethylene glycol treatment. In the future, further multi-center, prospective studies are needed to explore the mechanisms of action of related factors in depth.

Acknowledgments
None

Author's contributions
[Feng He]: Conceived and designed the research and analyzed data. Drafted and revised the manuscript critically for important intellectual content.
[Li Liu, Liyuan Quan]: Contributed to the acquisition, analysis and interpretation of data. Provided substantial intellectual input during the drafting and revision of the manuscript.
[Gaowei Ren]: Participated in the conception and design of the study. Played a key role in data interpretation and manuscript preparation.
All authors have read and approved the final version of the manuscript.

Funding
None

Data availability statement
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethical approval
This study has been reviewed and approved by The First Hospital of Qinhuangdao Medical Ethics Committee with approval number 2019H037. This study was performed in adherence with the STROBE guidelines. See supplementary file for the STROBE checklist.

Conflict of interest
The authors affirm that they do not have any financial conflicts of interest.

REFERENCES

Abd El Azeem AM, Alsharnoubi J and Abd El-Rahman Mohamed M (2023). Laser acupuncture improving functional chronic constipation in children: A randomized controlled trial. *Lasers Med. Sci.,* **38**(1): 72.

Adil S, Gordon M, Hathagoda W, Kuruppu C, Benninga MA and Rajindrajith S (2024). Impact of physical inactivity and sedentary behaviour on functional constipation in children and adolescents: A systematic review. *BMJ Paediatr. Open,* **8**(1): e003069.

Dias FC, Boilesen SN, Tahan S, Melli L and Morais MB (2023a). Overweight status, abdominal circumference, physical activity and functional constipation in children. *Rev. Assoc. Med. Bras. (1992),* **69**(3): 386-391.

Dias FC, Melli L, Boilesen SN, Tahan S and Morais MB (2023b). Hypohydration, functional constipation and physical activity in elementary school students. *J. Pediatr. Gastroenterol. Nutr.,* **77**(2): 203-206.

Dong M, Wu Y, Zhang M, Chen P, Zhang Z and Wang S (2023). Effect of probiotics intake on constipation in children: An umbrella review. *Front. Nutr.,* **1**(10): 1218909.

Gan D Chen J, Tang X, Xiao L, Martoni CJ, Leyer G, Huang G and Li W (2022). Impact of a probiotic chewable tablet on stool habits and microbial profile in children with functional constipation: A randomized controlled clinical trial. *Front. Microbiol.,* **22**(13): 985308.

Ghaderi F, Jamshidi M, Sarbakhsh P and Kharaji G (2023). Cross-cultural adaptation, validity and reliability of the pediatric constipation score-parent report in pediatric functional constipation in an iranian population. *Gastroenterol. Hepatol. Bed. Bench,* **16**(1): 486-491.

Gong S, Yu Z, Ding Y, Wang Y, Li X and Gu S (2025). Characteristics of functional constipation and analysis of intestinal microbiota in children aged 0-4 in zunyi region. *BMC Pediatr,* **25**(1): 45.

Gordon M, Grafton-Clarke C, Rajindrajith S, Benninga MA, Sinopoulou V and Akobeng AK (2024). Treatments for intractable constipation in childhood. *Cochrane. Database Syst. Rev.,* **6**(6): CD014580.

Hojsak I, Benninga MA, Hauser B, Kansu A, Kelly VB, Stephen AM, Morais Lopez A, Slavin J and Tuohy K (2022). Benefits of dietary fibre for children in health and disease. *Arch. Dis. Child.,* **107**(11): 973-979.

Huang Y, Tan SY, Parikh P, Buthmanaban V, Rajindrajith S and Benninga MA (2021). Prevalence of functional gastrointestinal disorders in infants and young children in china. *BMC Pediatr,* **21**(1): 131.

Huang YH, Xie C, Chou CY, Jin Y, Li W, Wang M, Lu Y and Liu Z (2023). Subtyping intractable functional constipation in children using clinical and laboratory data in a classification model. *Front. Pediatr.,* **24**(11): 1148753.

Article in Press

Kruger Howard A and Morgan JA (2024). Evaluation of polyethylene glycol dosing for functional constipation in children. *Hosp. Pharm,* **59**(6): 645-649.

Kumar K, Gupta N, Malhotra S and Sibal A (2023). Functional constipation: A common and often overlooked cause for abdominal pain in children. *Indian J. Gastroenterol,* **42**(2): 274-278.

Kwiatkowska M and Krogulska A (2021). The significance of the gut microbiome in children with functional constipation. *Adv. Clin. Exp. Med.,* **30**(4): 471-480.

Ladi-Seyedian SS, Sharifi-Rad L, Yousefi A, Alimadadi H, Farahmand F and Motamed F (2023). Management of intractable functional constipation in children by interferential therapy: Transabdominal or pelvic floor. *Dig. Dis. Sci.,* **68**(6): 2510-2517.

Liu S, Lu J, He Y, Zheng G, Liu S, Xiang Y, Wang X, Liu X and Xiao Y (2025). The sequential association between depression, anxiety and functional constipation among chinese children and adolescents: A mediation by resilience. *J. Affect. Disord.,* **1**(390): 119845.

Medicine, DSDPCOCaOI (2025). Expert consensus on integrated traditional chinese and western medicine diagnosis and treatment of functional constipation (2025). *Chin. J. Integr. Trad. West Med. Dig.,* **33**(33): 195-215.

Mulhem E, Khondoker F and Kandiah S (2022). Constipation in children and adolescents: Evaluation and treatment. *Am. Fam. Physician,* **105**(5): 469-478.

Niu Y, Liu T, Ran N, Li K, Sun Y, Wang X, Guo K and Yang X (2022). Relationship between family-related factors and functional constipation among chinese preschoolers: A case-control study. *BMC Pediatr,* **22**(1): 460.

Pan Y and Jiao FY (2025). Addressing functional constipation in children: A call for comprehensive and collaborative management. *World J. Gastroenterol.,* **31**(7): 98889.

Rajindrajith S, Gordon M, Dovey TM, Benninga MA and Sinopoulou V (2024). Dietary interventions for the management of chronic constipation in children. *Cochrane Database Syst. Rev.,* **23**(2): CD014865.

Salvatore S, Battigaglia MS, Murone E, Dozio E, Pensabene L and Agosti M (2023). Dietary fibers in healthy children and in pediatric gastrointestinal disorders: A practical guide. *Nutrients,* **15**(9): 2208.

Shen H, Zhang L, Zhang Y, Huang Y, Xu B and Yu M (2024). Facilitators and barriers of adherence to rectal interventions by parents of young children with functional constipation: A qualitative study. *Front Pediatr,* **9**(12): 1417389.

Tavassoli S, Eftekhari K, Karimi M, Ghobadi A, Shati M, Naddaf A and Abbassian A (2021). Effectiveness of viola flower syrup compared with polyethylene glycol in children with functional constipation: A randomized, active-controlled clinical trial. *Evid. Based Complement. Alternat. Med.,* **9**(2021): 9915289.

Tran DL and Sintusek P (2023). Functional constipation in children: What physicians should know. *World J. Gastroenterol.,* **29**(8): 1261-1288.

Vadlapudi SS, Poddar U, Srivastava A and Sarma MS (2025). Efficacy of home-based versus hospital-based disimpaction with polyethylene glycol in pediatric functional constipation: A randomized control study. *Dig. Dis. Sci.,* **70**(8): 2750-2759.

Velasco-Benitez CA, Gomez-Oliveros LF, Rubio-Molina LM, Tovar-Cuevas JR and Saps M (2021). Diagnostic accuracy of the rome iv criteria for the diagnosis of functional gastrointestinal disorders in children. *J. Pediatr. Gastroenterol. Nutr.,* **72**(4): 538-541.

Wegh CaM, Baaleman DF, Tabbers MM, Smidt H and Benninga MA (2022a). Nonpharmacologic treatment for children with functional constipation: A systematic review and meta-analysis. *J. Pediatr,* **240**: 136-149 e5.

Wegh CaM, Baaleman DF, Tabbers MM, Smidt H and Benninga MA (2022b). Nonpharmacologic treatment for children with functional constipation: A systematic review and meta-analysis. *J. Pediatr,* **240**: 136-149.e5.

West LN, Zakharova I, Huysentruyt K, Chong SY, Aw MM, Darma A, Hegar B, Ng RT, Hasosah M, Toro-Monjaraz E, Cetinkaya M, Chow CM, Muhardi L, Kudla U, Delsing DJM and Vandenplas Y (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.

Xiao P, Song T, Li XL, Xiao YM, Wang RX, Song FF, Li D, Zhang AH, Wang Y and Zhang T (2025). Effects of dietary fiber on chinese children with functional constipation and targeted modification of gut microbiota and related metabolites. *Front. Nutr.,* **14**(12): 1579668.

Yang WC, Zeng BS, Liang CS, Hsu CW, Su KP, Wu YC, Tu YK, Lin PY, Stubbs B, Chen TY, Chen YW, Shiue YL, Zeng BY, Suen MW, Hung CM, Wu MK and Tseng PT (2024). Efficacy and acceptability of different probiotic products plus laxatives for pediatric functional constipation: A network meta-analysis of randomized controlled trials. *Eur. J. Pediatr.,* **183**(8): 3531-3541.

Zhang X, Hu L, Li L, Wang Y, Zhang C, Su J, Di H, Gao Q, Tai X and Guo T (2022). Pediatric tuina for functional constipation in children: Study protocol for a randomized controlled trail. *Trials,* **23**(1): 750.

Zhao H, Lu X, Lou H, Ye Y, Ye H, Li W, Long Z, Zhang X, Wu J and Wang J (2025). Functional constipation in chinese infants: Disruptions in gut microbiota and

Article in Press

urinary metabolome revealed by a cross-sectional analysis. *Front. Microbiol*, **3**(16): 1649995.

Article in Press