

Functional gastrointestinal disorders in adolescents during online learning

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Abstract

Background The COVID-19 pandemic necessitated the use of online schooling in order to comply with national and local lockdown guidelines. Online learning required students and teachers to adapt to a new method of schooling. The inability of adolescents to adapt to their environment can interfere with their psychosocial condition and become a risk factor for functional gastrointestinal disorders (FGID).

Objective To determine the prevalence of FGID in adolescents and evaluate possible risk factors that existed during online learning. **Methods** This cross-sectional study was done in children aged 12-18 years who participated in online learning during the COVID-19 pandemic. The diagnosis of FGID was based on Rome IV criteria. Psychosocial problems were assessed using the *Pediatric Symptom Checklist Questionnaire-17* (PSC-17) which includes internalization, externalization, and attention subscales. Subjects with a PSC-17 mixed subscale total score of >15 were considered as having an increased likelihood of having a behavioral health disorder. Data were collected by online questionnaires via *Google Forms*.

Results Of 1,413 participants, 23% experienced FGID; of these, 32.6% had >2 FGID diagnostic criteria. Upon multivariate analysis, internalization psychosocial problems were the most common risk factors for FGID, followed by mixed subscale psychosocial problems, unstable internet connection, and not understanding of the material.

Conclusion The prevalence of FGID in adolescents in this study is 23%. Environmental and psychosocial conditions are interrelated as risk factors for FGID in adolescents during online learning in the COVID-19 pandemic. [Paediatr Indones. 2023;63:353-60; DOI: <https://doi.org/10.14238/pi63.5.2023.353-60>].

Keywords: Rome IV criteria; functional abdominal pain; adolescent; online learning

Functional gastrointestinal disorders (FGIDs) are a group of health problems that can impact children's quality of life if not recognized and treated early.¹⁻⁵ The Rome IV criteria classifies FGIDs in children into (1) functional nausea and vomiting, (2) functional abdominal pain, and (3) functional defecation disorders.⁶ The causes of FGIDs are multifactorial and associated with inflammatory processes, gastrointestinal motility, hypersensitivity of visceral organs, and composition of the gut microbiota.^{2,6}

The prevalence of FGIDs in adolescents varies from 10-30%, with a range of 10-20% in the European population and 6-30% in the Asian population.⁷⁻⁹ The large prevalence range can be caused by a variety of FGID risk factors. There have been limited studies in Indonesia, and most evaluated only one type of clinical symptom.⁹ Adolescents are very sensitive to rapid physical, emotional, and social changes.¹⁰ The link between emotional disturbance and FGIDs is not

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conclusive.¹¹ However, the inability to adapt to the environment can cause emotional disturbances and is a risk factor for FGIDs. Changing from the physical school classroom to online learning at home during the COVID-19 pandemic required students to adapt rapidly to new conditions.¹² The clinical symptoms of FGIDs in adolescents vary widely, therefore, research covering all of the FGID diagnostic criteria and their risk factors is interesting and necessary.

Methods

This cross-sectional study was conducted in junior high and high school children aged 12 to 18 years. The inclusion criteria were children aged 12-18 years registered at one of the schools where the study took place. Children were excluded when they suffered from a disease or were taking medications at the time of the study. The diagnosis of FGID was established based on the Rome IV diagnostic criteria.¹ Psychosocial problems were assessed using the *Pediatric Symptom Checklist Questionnaire-17* (PSC-17).¹³

The PSC-17 consists of 17 items divided into the internalization, externalization, and attention subscales. The internalization subscale consists of five items: feeling sad, hopelessness, looking down on oneself, gloomy outlook, and worrying about many things. The externalization subscale has seven items: refusing to share, inability to understand other people's feelings, fighting with other children, blaming others for one's troubles, disobeying rules, disturbing other children, and stealing. The attention subscale comprises five items: nervousness, frequent daydreaming, trouble concentrating, acting impulsively, and switching attention easily. Subjects were asked to rate each item as "never" (scored 0), "sometimes" (scored 1), or "often" (scored 2). Item scores within each subscale were added up to obtain the subscale score, and subscale scores were added up to obtain the total score. A child was considered as having psychosocial problems if his or her internalization score was ≥ 5 or externalization score was ≥ 7 or attention score was ≥ 7 or total score was ≥ 15 .¹³

We also collected data on internal and environmental conditions that may affect the risk of FGIDs, including the availability of a device for the

subject's own use, stability of internet connection, availability of a designated room for online learning, the subject's understanding of the learning material, satisfactory explanation of unclear material, and the subject's ability to complete assigned tasks. We analyzed the association between FGID and PSC-17 results, as well as internal and environmental conditions as potential risk factors for FGID in the period of online learning during the COVID-19 pandemic. Data were collected using online questionnaires via Google Forms completed by students from selected schools.

Data analysis was performed using SPSS *version 22* (IBM, Armonk, New York). Bivariate analysis was done using the non-parametric Fisher's exact test. A P value of <0.05 was considered statistically significant. Risk factors found to be statistically significant on bivariate analysis were included in multivariate analysis using a logistic regression model. Parents and children received an explanation regarding the purpose and benefits of the study as well as how to complete the questionnaire during an online meeting with the investigators. Parents we asked to provide written informed consent for their child's participation in the study. The study was approved by the Standing Committee on Medical/Health Research Ethics, Faculty of Medicine, Universitas Indonesia/ Dr. Cipto Mangunkusumo Hospital.

Results

Of the 2,314 junior and senior high school students initially selected, 1,413 met the inclusion criteria. The characteristics of subjects are listed in **Table 1**. Of the 1,413 adolescents included in the study, 325 (23%) experienced FGID, with a higher prevalence among high school than junior high school students. The distribution of FGID symptoms based on the Rome IV diagnostic criteria per group is shown in **Table 2**. Of the 325 students with FGID, 106 (32.6%) had >2 FGID diagnostic criteria.

Environmental conditions that significantly increased the risk of FGIDs in adolescents during online learning were unstable internet connection [RR 1.553 (95%CI 1.284 to 1.879); $P<0.01$], lack of a designated room for online learning [RR 1.288 (95%CI 1.063 to 1.560); $P=0.009$], not understanding learning materials [RR 1.658 (95%CI 1.373 to 2.002);

Table 1. Characteristics of study subjects

Characteristics	(N=1,413)
Sex, n (%)	
Female	890 (63)
Male	523 (37)
Education, n (%)	
Junior high school	649 (45.9)
Senior high school	764 (54.1)
Number of siblings, n (%)	
<2	565 (39.9)
≥2	848 (60.1)
Family situation, n (%)	
Living with one parent or not living with parents	215 (15.2)
Living with both parents	1198 (84.8)

$P < 0.001$], lack of explanation of unclear material [RR 1.402 (95%CI 1.093 to 1.799); $P = 0.011$], and inability to complete assigned tasks [RR 1.405 (95%CI 1.113 to 1.775); $P = 0.006$] (Table 3). There was an increased risk of FGID in adolescents with problems in each of the three psychosocial subscales comprising internalization, externalization, and attention during online learning (Table 4). Unstable internet connection [RR 1.267 (95%CI 1.066 to 1.506); $P = 0.009$], not understanding learning materials [RR 1,259 (95%CI 1.058 to 1.497; $P = 0.010$], and inability to complete assignments/tasks [RR 1.492 (95%CI 1.273 to 1.749); $P < 0.001$] were environmental conditions that increased the risk for psychosocial problems in adolescents who experienced FGIDs (Table 5).

Of the nine variables suspected as risk factors for FGID on bivariate analysis, only four were significant risk factors on multivariate analysis. Internalization [OR 1.765 (95%CI 1.252 to 2.488); $P = 0.001$] was the most influential factor, followed by mixed subscale problems [OR 1.631 (95%CI 1.049 to 2.534); $P = 0.030$], unstable internet connection [OR 1.423 (95%CI 1.067 to 1.898); $P = 0.016$], and not understanding the learning material [OR 1.359 (95%CI 1.013 to 1.821); $P = 0.040$] (Table 6).

Table 2. Prevalence of FGID and distribution of symptoms based on Rome IV criteria

Diagnosis	(N= 1,413)
Overall FGID, n(%)	325 (23)
Junior high school (12-15 years)	112 (7.9)
Senior high school (16-18 years)	213 (15.1)
No FGID	1,088 (77)
Number of FGID criteria met, n(%)	
1	219 (67.4)
≥2	106 (32.6)
Nausea and functional vomiting, n(%)	133 (9.4)
Cyclic vomiting syndrome	22 (1.5)
Functional nausea	59 (4.2)
Functional vomiting	6 (0.4)
Rumination syndrome	11 (0.8)
Aerophagia	35 (2.5)
Functional abdominal pain, n(%)	180 (12.7)
Functional dyspepsia	83 (5.9)
Irritable bowel syndrome	33 (2.3)
Abdominal migraine	24 (1.7)
Functional abdominal pain – NOS	40 (2.8)
Functional constipation disorders, n(%)	173 (12.2)
Functional constipation	146 (10.3)
Non-retentive fecal incontinence	27 (1.9)

NOS=not otherwise specified

Discussion

To the best of our knowledge, our study is the first to evaluate risk factors of FGID during online learning. We found a FGID prevalence of 23% in adolescents during online learning. Two pre-pandemic studies reported FGID in 25% of children aged 4-18 years in the Atlanta, Georgia, United States and in 10% of children aged 10-17 years in New Delhi, India.^{14,15} Of our participants, 14.5% met one FGID diagnostic criteria and 7.5% met >2 diagnostic criteria. A study in Gunma, Japan found that 12.3% of children met one FGID diagnostic criteria and 1.5% met two diagnostic criteria.¹⁶

Although the etiology of FGID is multifactorial, the social environment is believed to play a role in the pathophysiology of FGID.¹⁷ Children's ability to adapt to the risk factors around them is influenced by genetic factors, gender, and the social environment.¹⁸

A previous study conducted in Indonesian children aged 10-17 years assessing functional abdominal pain, one of the diagnostic criteria of FGID, reported a functional abdominal pain prevalence of 11.5%. In the study, 3.3% of subjects had functional dyspepsia, 2% had irritable bowel syndrome (IBS),

Table 3. Analysis of environmental conditions during online learning and FGID

Environmental conditions	FGID		RR (95%CI)	P value
	Positive (n=325)	Negative (n=1,088)		
Use of own mobile or laptop				
No	9 (2.8)	43 (3.9)	0.745 (0.408 to 1.361)	0.302 ^a
Yes	316 (97.2)	1,045 (96.1)		
Stable internet connection				
No	132 (40.6)	300 (27.6)	1.553 (1.284 to 1.879)	<0.001 ^a
Yes	193 (59.4)	788 (72.4)		
Use of a designated room				
No	176 (54.2)	500 (45.9)	1.288 (1.063 to 1.560)	0.009 ^a
Yes	149 (45.8)	588 (54.1)		
Understood the material				
No	139 (42.8)	300 (27.6)	1.658 (1.373 to 2.002)	<0.001 ^a
Yes	186 (57.2)	788 (72.4)		
Unclear material explained				
No	52 (16)	117 (10.6)	1.402 (1.093 to 1.799)	0.011 ^a
Yes	273 (84)	971 (89.4)		
Able to complete assigned tasks independently				
No	62 (19.1)	141 (12.9)	1.405 (1.113 to 1.775)	0.006 ^a
Yes	263 (80.9)	947 (87.1)		

^aChi-square; RR=relative risk**Table 4.** Analysis of psychosocial conditions and FGID

Psychosocial problems	FGID		RR (95%CI)	P value
	Positive (n=325)	Negative (n=1,088)		
Internalization (score >5)				
No	185 (56.9)	333 (30.6)	2.283 (1.886 to 2.764)	<0.001 ^a
Yes	140 (43.1)	755 (69.4)		
Externalization (score >7)				
No	21 (6.5)	31 (2.8)	1.808 (1.281 to 2.552)	0.002 ^a
Yes	304 (94.5)	1057 (97.2)		
Attention (score >7)				
No	89 (27.4)	129 (11.8)	2.067 (1.698 to 2.516)	<0.001 ^a
Yes	236 (72.6)	959 (88.2)		
Mixed subscale (score >15)				
No	136 (41.8)	201 (18.5)	2.298 (1.913 to 2.760)	<0.001 ^a
Yes	189 (58.2)	887 (81.5)		

^aChi-square; RR=relative risk

0.4% had abdominal migraine, and 5.8% had other functional abdominal pain.⁹ Another study in Indonesian children aged 13-18 years noted an IBS prevalence of 6%.¹⁹ In a study on functional abdominal pain in Sri Lankan children, the prevalences of IBS, functional dyspepsia, abdominal migraine, and other functional abdominal pain were 7.0%, 3.5%, 0.2%, and 3.0%, respectively.²⁰ Epidemiological surveys in Indian adolescents noted the following prevalences: functional dyspepsia 2.7%, abdominal migraine 1.4%,

IBS 1.3%, and other functional abdominal pain 0.3%.¹⁵ In our study, the prevalence of functional abdominal pain was 12.7%, which included functional dyspepsia (5.9%), IBS (2.3%), abdominal migraine (1.7%), and other functional abdominal pain (2.8%) (Table 2). The differences in prevalence may have been influenced by genetic factors, inflammation (allergies, infections), or motility disorders, which cause hypersensitivity of the gastrointestinal tract with manifestations of abdominal pain. Anxiety, ability to

Table 5. Analysis of environmental conditions and psychosocial problems in 325 adolescents with FGID

Environmental conditions	Psychosocial problems (Total score > 15)		RR (95%CI)	P value
	Yes (n=196)	No (n=129)		
Use of own mobile or laptop				
No	6 (66.7)	3 (33.3)	1.109 (0.693 to 1.775)	0.693 ^a
Yes	190 (60.1)	126 (39.9)		
Stable internet connection				
No	91 (68.9)	41 (31.1)	1.267 (1.066 to 1.506)	0.009 ^a
Yes	105 (54.4)	88 (45.6)		
Use of a designated room				
No	112 (63.6)	64 (36.4)	1.129 (0.943 to 1.351)	0.183 ^a
Yes	84 (56.4)	65 (43.6)		
Understood the material				
No	95 (68.3)	44 (31.7)	1,259 (1.058 to 1.497)	0.010 ^a
Yes	101 (54.3)	85 (45.7)		
Unclear material explained				
No	33 (63.5)	19 (36.5)	1.063 (0.846 to 1.335)	0.612 ^a
Yes	163 (59.7)	110 (40.3)		
Able to complete assigned tasks				
No	51 (82.3)	11 (17.7)	1.492 (1.273 to 1.749)	<0.001 ^a
Yes	145 (55.1)	118 (44.9)		

^aChi-square; RR=relative risk

Table 6. Bivariate and multivariate logistic regression analyses of environmental factors during online learning and FGID

Variables	Bivariate analysis OR (95%CI)	Pvalue*	Multivariate analysis OR (95%CI)	P value*
Having own computing device	0.745 (0.408 to 1.361)	0.302		
Unstable internet connection	1.553 (1.284 to 1.879)	<0.001	1.423 (1.067 to 1.898)	0.016
Lack of a designated room	1.129 (0.943 to 1.351)	0.009	1.125 (0.858 to 1.474)	0.394
Not understanding the material	1.658 (1.373 to 2.002)	<0.001	1.359 (1.013 to 1.821)	0.040
Explanation of unclear material	1.402 (1.093 to 1.799)	0.011	1.240 (0.841 to 1.829)	0.278
Unable to complete assigned tasks	1.492 (1.273 to 1.749)	<0.001	0.866 (0.593 to 1.265)	0.456
Internalization problem	2.283 (1.886 to 2.764)	<0.001	1.765 (1.252 to 2.488)	0.001
Externalization problem	1.808 (1.281 to 2.552)	0.002	1.307 (0.696 to 2.456)	0.405
Attention problem	2.067 (1.698 to 2.516)	<0.001	1.166 (0.768 to 1.770)	0.471
Mixed subscale problem	2.298 (1.698 to 2.516)	<0.001	1.631(1.049 to 2.534)	0.030

*significant P < 0.05

handle complaints, history of trauma, and cultural differences are other risk factors that can influence clinical symptoms.¹⁸

The COVID-19 pandemic put parents in a position of trying to balance their personal needs, work, and their ability to accompany their children during online learning at home. Parents needed to adapt in providing care support.²¹ An imbalance between risk factors and protective factors can cause functional disorders in adolescents.¹⁸ Effective

interaction between adolescents, parents, and other family members was a protective factor that helped overcome problems during online learning. Risk factors need to be identified and addressed, as they contribute to the persistence and severity of the problem.^{22,23} Environmental conditions including unstable internet connection, lack of a designated room, lack of understanding of learning materials, lack of explanation of unclear material, and inability to complete assignments were risk factors for FGIDs

in adolescents during online learning. Prolonged duration of FGIDs affect the quality of life and health of adolescents.²⁴ A study of 30 junior high, senior high, and college students in the remote North Tapanuli region of Indonesia showed that online learning was considered less effective than classroom learning, because communication networks and infrastructure were inadequate for online learning.²⁵

We found that adolescents with internalization and mixed subscale psychosocial problems were at higher risk of experiencing FGID [OR 2.28 (95%CI 1.89 to 2.76) and 2.30 (95%CI 1.91 to 2.76), respectively]. Internalization psychosocial problems are common in adolescents.²⁶ Depression influences the development and exacerbation of FGIDs.²⁷ Involvement of the emotional-motor system induces gastrointestinal hypersensitivity in IBS.²⁸ Adolescents with high levels of psychosocial stress have the potential to experience IBS.²⁹ Mature emotions and behaviors play a role in responding to impulses.¹⁸ Of the 325 adolescents with FGID in our study, 60.3% had psychosocial problems, whereas those with unstable internet connection, lack of understanding of learning materials, and inability to complete assignments/tasks were at higher risk for psychosocial problems (Table 5). One study of 676 junior high school children in Yogyakarta, Indonesia found that 34.6% of subjects had psychosocial and behavioral problems, with problems in peer relations being the most common. Adolescents with longer screen time and more family conflicts were more likely to have psychosocial and behavioral problems.³⁰

In our study, multivariate analysis revealed that four conditions were significant risk factors for FGIDs in adolescents during online learning. Internalization problems were the most influential risk factor, followed by unstable internet connection, mixed subscale psychosocial problems, and lack of understanding of learning materials. These findings were in agreement with other studies which found that psychosocial conditions, adaptation to the environment, and attention were factors that influenced the development and exacerbation of FGIDs.^{26,27}

In conclusion, the prevalence of FGIDs in adolescents during online learning in the COVID-19 pandemic was not much different from pre-pandemic conditions. Environmental conditions and psychosocial

problems are interrelated factors that may increase the risk for FGID in adolescents. Internalization, mixed subscale psychosocial problems, unstable internet connection, and lack of understanding of learning materials are significant risk factors for FGID in adolescents during online learning.

Conflict of interest

None declared.

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