

Original Article

Fast foods - are they a risk factor for functional gastrointestinal disorders?

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Background and Objectives: Fast-food consumption has greatly increased in Taiwan. Frequent fast food intake is associated with both allergy and obesity. The aim of this study was to describe fast food habit changes, and to assess the relationship between fast food intake and the risk of functional gastrointestinal disorders (FGIDs) among Taiwanese adolescents. **Methods and Study Design:** This analysis used data from the Nutrition and Health Survey in Taiwan (NAHSIT) of high school students conducted in 2011. A total of 2,042 adolescents (12-19 years) completed the questionnaire. The survey included the Rome III criteria for FGIDs, translated into Chinese for adolescents. Respondents with previously diagnosed chronic organic gastrointestinal diseases were excluded from the study. **Results:** In total, 2,034 children were enrolled. 545 subjects (26.8%) had history of at least one FGID. 88.1% of the subjects reported fast foods consumption. A significantly higher prevalence of FGIDs was noted in adolescents with a history of fast foods consumption, compared with those reported not to have ingested fast foods in the past 30 days (27.6% vs 20.6%, $p=0.024$). An increased risk of FGIDs in children and adolescents was associated with fast food intake (OR 1.8, 95% CI: 1.78-1.83). **Conclusions:** FGIDs were common among Taiwanese adolescents. Fast-food consumption may contribute to a positive association with the development of functional gastrointestinal disorders. Lower fiber intake and more frozen desserts in the diet may be complicit in FGIDs. The findings have public health relevance in regard to the global increase in fast food consumption.

Key Words: fast foods, frozen desserts, vegetables, functional gastrointestinal disorders, Rome III criteria

INTRODUCTION

Functional gastrointestinal disorders (FGIDs) are a group of disorders of the digestive system with chronic or recurrent symptoms in the absence of other pathologically based disorders causing significant public health burden.¹ As these disorders lack objective measurable abnormalities, the clinical symptoms are important clues for diagnosis. The Rome criteria series were established as the gold standard for the classification of such disorders. The reliable diagnosis of functional gastrointestinal disorders (FGIDs) has been shown to base on researches utilizing the Rome criteria by means of self-reported questionnaires. Rome III criteria were announced in 2006.² The FGIDs are classified into 10 categories by symptom-based Rome III diagnostic criteria in adolescents.^{3,4}

The prevalence of FGIDs in the general population in many countries is increasing.⁵ Patients with FGIDs were often affected both physically and psychosocially and the consequences of these disorders not only affect each individual but also have massive influence on the society and nation as a whole.¹ The risk factors associate with FGIDs include as life style,⁵ emotional stress,⁶ sleep problems,⁷ and dietary habits.² As a developing country, the diet habits are moving away from the traditional diet of traditional

food as they become more westernized. However, fast food has detrimental effects on health, which have been a matter of discussion for more than 20 years. Fast food is known to be an obvious factor in dietary patterns associated with obesity, cardiovascular disease, type 2 diabetes mellitus, allergy,⁸ and hepatotoxicity.^{9,10} Here we aimed to investigate the associations between the prevalence of FGIDs and fast food intake among Taiwanese teenagers.

MATERIALS AND METHODS

Subjects

Regular assessment of the population's nutrition and health status has become an important aspect of public health in Taiwan. In 2011-2012, the Taiwan's Food and

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Drug Administration Board Bureau of the Department of Health carried out a nationwide nutrition and health survey in Taiwan (NAHSIT) (<http://nahsit.nhri.org.tw/>) that focused on the nutrition and health status of the adolescent population. Study subjects aged between 12 to 19 years old and currently studying in junior high, senior high and vocational school were selected through a complex multi-staged sampling with equal distribution of age and sex from each region. A total of 2,495 children were chosen from a random sample of schools in a defined geographical area and 2,256 subjects agreed to answer the questionnaires. Finally, 2,042 (90.5%) responders completed the food frequency and Rome III questionnaires (see below). Of these, 2,034 (99.6%) (1,002 boys and 1,032 girls) with no known organic diseases were enrolled in the study (Figure 1).

Questionnaire

The survey in our current study consisted of a translated and validated Rome III for functional gastrointestinal disorders (FGIDs) modified self-report form questionnaire for adolescents,² and 6 questions regarding the frequency of consumption of different food groups. The Rome III modified questionnaire for children and adolescents was developed by the Rome III working group in 2006 and includes 62 questions addressing gastrointestinal symptoms of the respondent. Based on the answers from the 62 questions, adolescents who meet the diagnostic criteria can then be categorized into 10 disorders which include: cyclic vomiting syndrome, aerophagia, adolescent rumination syndrome, functional dyspepsia, irritable bowel syndrome, abdominal migraine, functional abdominal pain, functional abdominal pain syndrome, functional constipation and non-retentive fecal incontinence. The survey also included food frequency questionnaire, the diet consumption during the past month of the respondents were assessed, including the food frequency of about the consumption of fast foods, frozen desserts and vegetables

Procedures and statistical methods

We calculated the prevalence (n, %) of multiple functional gastrointestinal disorders according to the Rome III criteria. The FGIDs and food frequency associations were analyzed using chi-square tests for categorical variables. The comparisons between continuous variables were done by Student t-test. For all tests, results with *p* values of less than 0.05 were considered to be statistically significant. All statistical analysis and procedures were performed using SPSS 20.0 statistical package. The institute review board of Academia Sinica has approved this study and the informed consent was obtained from each subject.

RESULTS

In total, 2,034 children (1,002 boys and 1,032 girls) were enrolled. The demographic features of the study population were shown in Table 1. Of these, five hundred and forty-five respondents (26.8%) had at least one FGID. A higher prevalence was noted among girls compared to boys (35.9% vs 18.4%, $p < 0.001$). Functional constipation (17.9%) was the leading cause of FGIDs in Taiwanese

adolescents. Irritable bowel syndrome (3.81%) and abdominal migraine (2.81%) was the second and third most commonly diagnosed FGID (Figure 2). The above three subgroups consisted over 95% of all FGIDs in the teenagers, and the remaining disorders such as functional abdominal pain syndrome, erophagia, rumination, cyclic vomiting syndrome and fecal incontinence were uncommon in this study, thus this study focus on the top three disorders. The prevalence FGIDs was noted among girls compared to boys (35.9% vs 18.4%, $p < 0.001$), particularly in category of constipation (Figure 2). From the diet recall, during the past month, 88.1% of the subjects reported fast food consumption, 50% has intake frozen deserts, and 31% has intake vegetable more than 3 serving per day. The prevalence of FGIDs was higher in adolescents with a history of fast food consumption, as compared with those was not (27.6% vs 20.6%, $p = 0.024$) and the odds ratio (OR) of FGIDs was 1.46 (95% CI: 1.06 to 2.03) for fast food consumers. Children with FGIDs also consumed fast food more frequently than those without FGIDs (1.9 vs 1.7 times per week $p < 0.05$). Frozen dessert intake (≥ 1 times per month) was associated with FGIDs

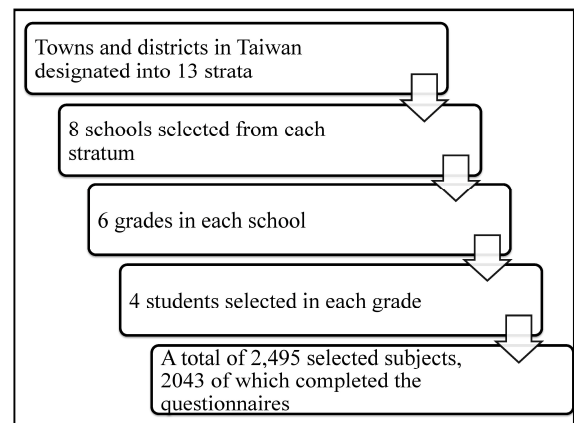


Figure 1. Structure flow chart of the selected children included in the NAHSIT 2010-2011 study

Table 1. Demographic features of the study population (n=2,034)

Characteristics	n	%
Age		
12	191	11.9
13	299	13.1
14	301	12.5
15	250	19.9
16	360	16.2
17	431	18.5
18	187	7.22
19	15	0.64
Sex		
Men	1002	52.4
Women	1032	47.6
Grade		
7 th	294	16.4
8 th	291	12.5
9 th	289	20.4
10 th	384	17.7
11 th	385	16.7
12 th	391	16.4

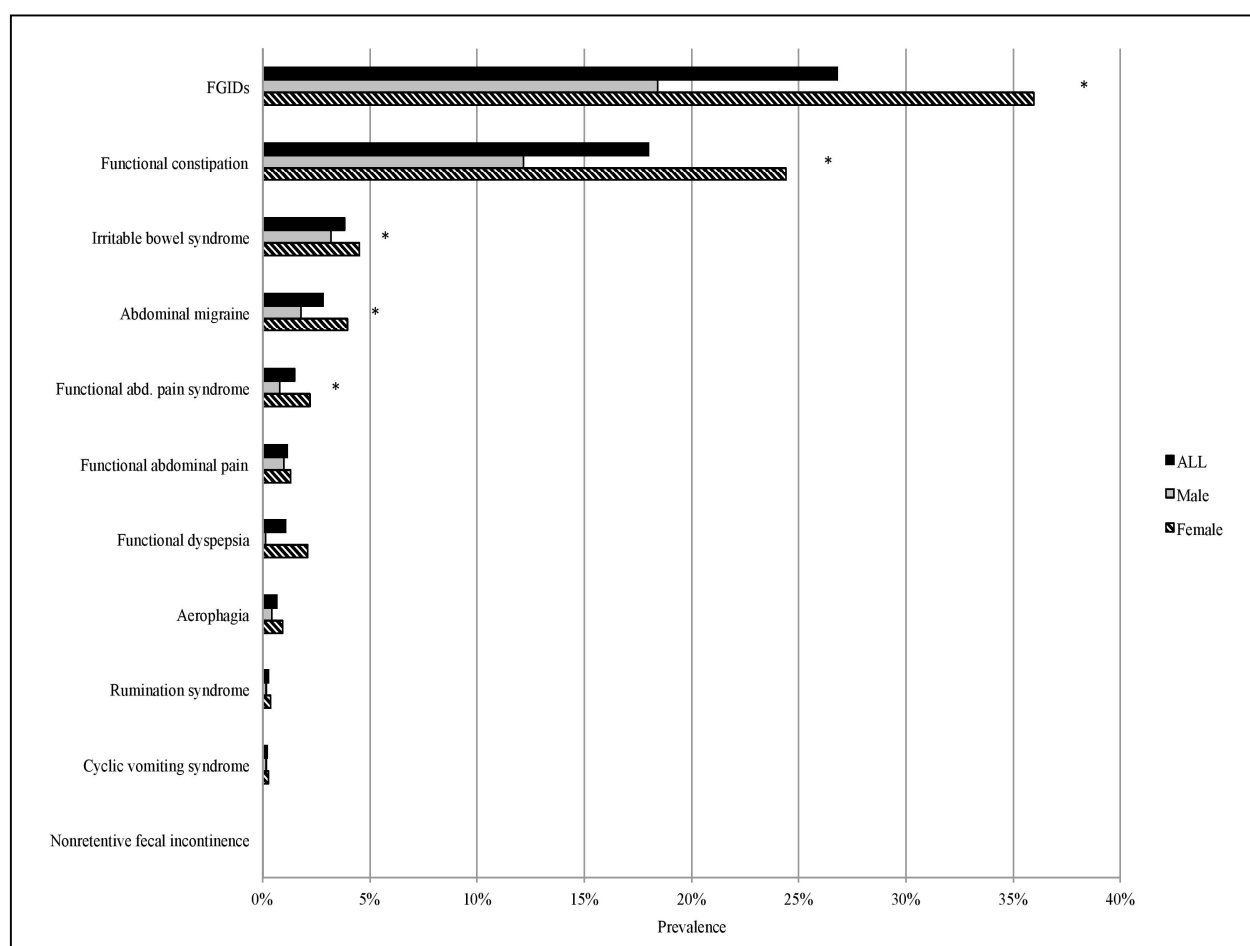


Figure 2. Prevalence of functional gastrointestinal disorders in children and adolescents age 12-19. *Denote statistic significant between boys and girls at $p < 0.05$ (Yates' chi square test).

Table 2. Effects of fast foods, frozen desserts, and vegetables consumption on FGIDs

	Consumption, n (%)	No consumption, n (%)	<i>p</i> value	OR (95% CI)
Fast foods [†]				
FGIDs	494 (27.6)	51 (20.6)	0.024	1.46 (1.06 to 2.03)
Non-FGIDs	1,293 (72.3)	196 (79.3)		
Frozen desserts				
FGIDs	311 (30.8)	234 (22.9)	<0.001	1.50 (1.23 to 1.83)
Non-FGIDs	700 (69.2)	789 (77.1)		
Vegetables (≥ 3 servings/d)				
FGIDs	142 (22.2)	402 (28.9)	0.002	0.70 (0.56 to 0.88)
Non-FGIDs	497 (77.8)	991 (71.1)		

[†]Yates' chisquare test.

(OR 1.50, 95% CI: 1.23 to 1.83) (Table 2). Abdominal-migraine had the most significant association with FGIDs (4.15% vs 1.95%, $p=0.0043$) (Figure 3). While those who ate 3 or more daily servings of vegetables suffered from fewer FGIDs compared with those that did not (22.2% vs 28.9%, OR 0.70, $p=0.002$) (Table 2). The relationship of frozen desserts and vegetables intake and the subgroups of FGIDs are shown in Figure 3. Moreover, there is no association between the frequency of fast food intake and vegetable consumption ($p=0.20$ and 0.15 for girls and boys respectively, by Fisher's exact test).

DISCUSSION

This study demonstrates the prevalence of FGIDs is not uncommon among the teenagers (26.8%); the categories

of function constipation, IBS and abdominal migraine account the majority of them (95%). Commonly, FGIDs are more prevalent in female than male (Figure 2). Although the reason for this observation is obscure, previous studies suggest that sex difference may be caused by in visceral perception, cardioautonomic responses, gastrointestinal motility, brain activation patterns to visceral stimuli, sex hormones and psychosocial factors.¹¹

Previous studies suggest eating fast foods has been linked to a number of different health conditions. Some of these conditions may lead to permanent disability or even death. For example, the childhood obesity epidemic is a current public health priority in many countries. A recent study in the United Kingdom has shown that the consumption of fast food was associated with a higher BMI;

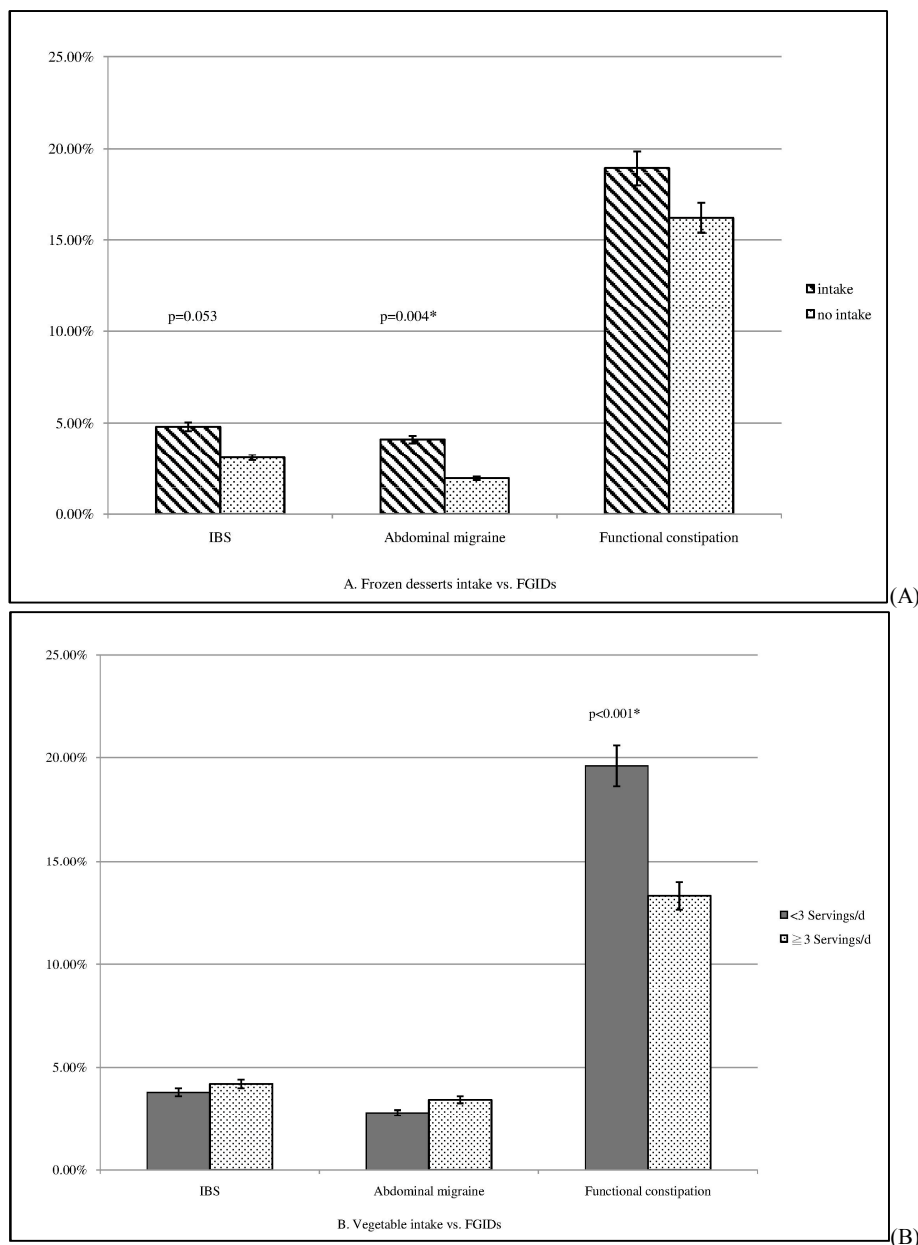


Figure 3. Association between prevalence of subgroups of functional gastrointestinal disorders and diet. *Yates' chi square test.

higher body fat composition and increased odds of being obese (OR=1.23, 95% CI=1.02, 1.49).¹² In a 15-year prospective analysis of the Coronary Artery Risk Development in Young Adults (CARDIA) study, fast-food consumption has strong positive associations with weight gain and insulin resistance, suggesting that fast food increases the risk of obesity and type 2 diabetes.¹³ Similar results have been observed in Asia.¹⁴ In addition, fast food consumption may also be contributing to the increasing prevalence of asthma, rhino conjunctivitis and eczema in adolescents and children.¹⁵ The unique finding of our study demonstrates that the consumption of fast foods was consistently associated with FGIDs namely functional constipation; irritable bowel syndrome and abdominal migraine.

The exact mechanisms of these relationships remain unclear. However, high sugar, fat, and sodium, and the significant amount of trans fatty acids in fast food suggest possible mechanisms for causing FGIDs. Dietary fat intake also modulates GI function in healthy humans. For

example, the slowing of gastric emptying by fat and the stimulatory effects of intraduodenal lipid on pyloric pressures has been reported to attenuate. However, the slowing of gastric emptying and small bowel transit may be associated to an increased number of reflux episodes. These mechanisms may contribute to GER, functional dyspepsia and IBS.¹⁶ Furthermore, the content of trans fatty acids in fast foods, the contents of trans fatty acids account for up to 50% of the fat in the products.¹⁷ Numerous reports have shown that intake of trans-unsaturated fats may also influence intestinal inflammation and regulate mucosal immunity and be associated with an increased risk of inflammatory bowel disease.¹⁸ These alterations in the GI motility, mucosal immunology and inflammation, may be involved in the pathogenesis and pathophysiology of FGIDs.

Consistent with international dietary recommendations, regular consumption of fruit and vegetables seems to protect against the development of FGIDs. In the previous study, Wu et al found that childhood constipation was

related to decreased daily intake of fruit and vegetables.¹⁹ A questionnaire survey of 15,000 adult members of the general public in Japan by Miwa H also show that FGID sufferers had a trend to consume less servings of vegetables compared to healthy respondents (2.28±1.47 vs 2.49±1.53, $p=0.07$).⁵ We found a similar result that adequate intake of vegetables suffered from fewer FGIDs compared with those that did not (22.2% vs 28.9%, OR 0.70, $p=0.002$). Fiber has long been used for the treatment of various gastrointestinal and non-gastrointestinal conditions. The dietary fiber includes non-digestible class of carbohydrates and digestible, glycemic carbohydrates such as sugars and starches. Undigested carbohydrate that reaches the colon will be fermented by the gut bacteria to produce short-chain fatty acids (SCFAs) and a number of gases, including carbon dioxide, hydrogen, and methane. SCFA contribute to normal large bowel function and prevent pathology through their actions in the lumen and on the colonic musculature and vasculature and through their metabolism by colonocytes.^{20,21} The fermentation of fiber also influences fecal bulking in an indirect manner as fermentation by colonic microflora stimulates growth and results in increased microbial biomass.²² For example, butyrate is a short-chain fatty acid produced by the catabolism of undigested carbohydrates in the intestine. It is a major energy source for the colon, and has an important role in intestinal growth and differentiation, inflammatory suppression, and regulation of apoptosis.^{23,24}

It is relatively common that frozen dessert ingestion often induced abdominal symptoms in patients with GI upset. In Asian culture, it is important to keep in harmonious balance through diet and lifestyle.²⁵ Ice-cold foods are traditionally considered imperil to the gastrointestinal and respiratory system. Previous studies have shown that cold-water intake leads to abdominal symptoms in symptomatic diarrhea predominant IBS patients.²⁶ For all respondents in this study, frozen desserts ingestion was positively associated with FGIDs. Abdominal migraine showed the most significant association with frozen desserts intake. The possible mechanism is that cold food or drink may affect the peristalsis, secretory, vasomotor, and vagal reflexes of gastrointestinal tract and induces visceral hypersensitivity or hyperalgesia by cold-sensitive thermal-receptors and 5-HT-mediated pathways.²⁶⁻²⁹ These studies suggested a possible association between increasing prevalence of FGIDs and frozen dessert ingestion.

Our results suggest that fast foods, frozen desserts and inadequate vegetable intake may contribute to the increasing prevalence of FGIDs. They highlight the importance of promoting healthy meal consumption with more vegetables, while minimizing the intake of fast foods and frozen desserts in order to reduce the risk of FGIDs among adolescents. The findings have public health relevance requiring more proactive policy counter the global increase in fast food consumption.

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AUTHOR DISCLOSURES

Jian-Ping Shau, Po-Hon Chen, Chan-Fai Chan, Tzee-Chung Wu, Li-Shu Wang, and Wen-Han Pan, report no conflicts of interest to declare.

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Appendix

Childhood Functional GI Disorders: Child/Adolescent
H1. VOMITING AND AEROPHAGIA
H1a. Adolescent Rumination Syndrome (Diagnostic criteria: Must include All of the following) 1. Repeated painless regurgitation and rechewing or expulsion of food that a. begin soon after ingestion of a meal b. do not occur during sleep c. do not respond to standard treatment for gastroesophageal reflux 2. No retching 3. No evidence of an inflammatory, anatomic, metabolic, or neoplastic process that explains the subject's symptoms Criteria fulfilled for the last 3 months with symptom onset at least 6 months prior to diagnosis
H1b. Cyclic Vomiting Syndrome (Diagnostic criteria: Must include both of the following) 1. Two or more periods of intense nausea and unremitting vomiting or retching lasting hours to days 2. Return to usual state of health lasting weeks to months
H1c. Aerophagia (Diagnostic criteria: Must include at least two of the following) 1. Air swallowing 2. Abdominal distention due to intraluminal air 3. Repetitive belching and/or increased flatus Criteria fulfilled at least once per week for at least 2 months prior to diagnosis
H2. ABDOMINAL PAIN-RELATED FUNCTIONAL GI DISORDERS
H2a. Functional Dyspepsia (Diagnostic criteria: Must include All of the following) 1. Persistent or recurrent pain or discomfort centered in the upper abdomen (above the umbilicus) 2. Not relieved by defecation or associated with the onset of a change in stool frequency or stool form (i.e., not irritable bowel syndrome) 3. No evidence of an inflammatory, anatomic, metabolic or neoplastic process that explains the subject's symptoms Criteria fulfilled at least once per week for at least 2 months prior to diagnosis
H2b. Irritable Bowel Syndrome (Diagnostic criteria: Must include both of the following) 1. Abdominal discomfort** or pain associated with two or more of the following at least 25% of the time: a. improvement with defecation b. onset associated with a change in frequency of stool c. onset associated with a change in form (appearance) of stool 2. No evidence of an inflammatory, anatomic, metabolic, or neoplastic process that explains the subject's symptoms Criteria fulfilled at least once per week for at least 2 months prior to diagnosis ** "Discomfort" means an uncomfortable sensation not described as pain.
H2c. Abdominal Migraine (Diagnostic criteria: Must include both of the following) 1. Paroxysmal episodes of intense, acute periumbilical pain that lasts for 1 hour or more 2. Intervening periods of usual health lasting weeks to months 3. The pain interferes with normal activities 4. The pain is associated with 2 of the following: a. Anorexia b. Nausea c. Vomiting d. Headache e. Photophobia f. Pallor 5. No evidence of an inflammatory, anatomic, metabolic, or neoplastic process considered that explains the subject's symptoms Criteria fulfilled two or more times in the preceding 12 months.
H2d. Childhood Functional Abdominal Pain (Diagnostic criteria: Must include all of the following) 1. Episodic or continuous abdominal pain 2. Insufficient criteria for other FGIDs 3. No evidence of an inflammatory, anatomic, metabolic, or neoplastic process that explains the subject's symptoms Criteria fulfilled at least once per week for at least 2 months prior to diagnosis
H2d1. Childhood Functional Abdominal Pain Syndrome (Diagnostic criteria: must satisfy criteria for childhood functional abdominal pain and have at least 25% of time one or more of the following) 1. Some loss of daily functioning 2. Additional somatic symptoms such as headache, limb pain, or difficulty sleeping Criteria fulfilled at least once per week for at least 2 months prior to diagnosis

Appendix

Childhood Functional GI Disorders: Child/Adolescent (cont.)
H3. CONSTIPATION AND INCONTINENCE
<p>H3a. Functional Constipation (Diagnostic criteria: must include two or more of the following in a child with a developmental age of at least 4 years with insufficient criteria for diagnosis of IBS)</p> <ol style="list-style-type: none"> 1. Two or fewer defecations in the toilet per week 2. At least one episode of fecal incontinence per week 3. History of retentive posturing or excessive volitional stool retention 4. History of painful or hard bowel movements 5. Presence of a large fecal mass in the rectum 6. History of large diameter stools which may obstruct the toilet <p>Criteria fulfilled at least once per week for at least 2 months prior to diagnosis</p>
<p>H3b. Nonretentive Fecal Incontinence (Diagnostic criteria: Must include all of the following in a child with a developmental age at least 4 years)</p> <ol style="list-style-type: none"> 1. Defecation into places inappropriate to the social context at least once per month 2. No evidence of an inflammatory, anatomic, metabolic, or neoplastic process that explains the subject's symptoms 3. No evidence of fecal retention <p>Criteria fulfilled for at least 2 months prior to diagnosis</p>

(Ref: <http://www.romecriteria.org/criteria/>)

Original Article

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速食是否為功能性胃腸病的風險因子？

背景和目的：速食的消費在台灣已有大幅的增加，而頻繁攝取速食與過敏及肥胖有關。本研究的目的在於描述食速食習慣的變遷，並評估在台灣青少年族群中速食攝取與功能性胃腸病風險間的關係。**方法與研究設計：**本分析資料源自於 2011 年台灣學生營養健康狀況變遷調查，共有 2,042 位青少年（12-19 歲）完成本問卷，之中含有功能性胃腸病羅馬 III 標準的中文版調查。並將已被確診患有器官性腸胃道疾病之受訪者排除。**結果：**共有 2,034 位孩童參與，其中 545 位（26.8%）有至少一種功能性胃腸病的病史，88.1% 有食速食史。而相較於在一個月內都無食速食孩童，食速食孩童有明顯更高的功能性胃腸病盛行率（27.6% vs 20.6%， $p=0.024$ ）。兒童及青少年罹患功能性胃腸病風險的增加（OR 1.8，95% CI：1.78-1.83）也與吃速食有所關聯。**結論：**功能性胃腸病在台灣青少年族群中是很普遍的，而常食速食與功能性胃腸病的產生有關。另外，低量纖維素的攝入與冰冷食物也可能與造成功能性胃腸病有關。我們的發現是與全球日益增加的速食消費相關的公共衛生議題。

关键词：速食、冰冷食物、蔬菜、功能性胃腸病、羅馬 III 標準