Original Article

Prevalence of functional gastrointestinal disorders in Taiwan: questionnaire-based survey for adults based on the Rome III criteria

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Functional gastrointestinal disorders (FGID) are a group of disorders of the digestive system in which the chronic or recurrent symptoms cannot be explained by the presence of structural or tissue abnormality. This survey used a modified Rome III questionnaire on the health and nutrition status of a general population in Taiwan during 2005-2008. A total of 4,275 responders completed the questionnaire. The sample was evenly distributed for men (n=2,137) and women (n=2,138). The prevalence of FGID was 26.2%. Unspecified functional bowel disorder was the most prevalent (8.9%). The second was functional dyspepsia (5.3%), and the third were irritable bowel syndrome (4.4%) and functional constipation (4.4%). Women had a greater prevalence than males (33.2% compared to 22.4%, $p<0.05$) with regards to total FGID. Most categories of FGID were significantly prominent in women, except functional diarrhea. The FGID groups took fewer servings of vegetables and fruits than the non-FGID group each day (vegetables 2.51 vs 2.70, $p<0.001$; fruits 0.82 vs 0.91, $p<0.001$). Smoking, alcohol consumption, and betel nut chewing had no significant impaction on prevalence of FGID. The mean BSRS (brief-symptom rating scale) for screening depression and suicide ideation was higher in the FGID group (2.86 vs 1.63, $p<0.001$). In conclusion, FGID diagnosed with Rome III criteria are not uncommon in Taiwan's general population. Subjects who met the Rome III criteria for FGID in Taiwan were younger, had less vegetables and fruits intake, higher BSRS scores and were of greater female predominance.

Key Words: Rome criteria, functional gastrointestinal disorders, irritable bowel syndrome, functional constipation, prevalence

INTRODUCTION

Functional gastrointestinal disorders (FGID) are a group of disorders of the digestive system in which the chronic or recurrent symptoms cannot be explained by the presence of structural or tissue abnormality.[1] These disorders lack objective measurable abnormalities, and as a result the clinical symptoms are important clues for diagnosis. Therefore the Rome criteria series were established as the gold standard for the classification of such disorders. In 1992, Rome I criteria were derived from expert clinical consensus and used as a reliable diagnostic standard for FGID.[2] The Rome criteria was revised in 1999 to be more simple and practical to use, and the Rome II criteria were mostly different from Rome I with regards to the duration of symptoms required for diagnosis.[2] Under the consideration of the wax and wane course of FGID, Rome II criteria required symptoms to be present for only at least 12 weeks in the past year, and these 12 weeks did not need to be consecutive as was defined in the Rome I criteria. Rome III criteria were announced in 2006 and changed the required duration of symptoms from the "last 12 months" to the "past six months."[3]

During a review of the related literature, we could find a number of studies which mostly focused on specific FGID, such as functional dyspepsia or irritable bowel

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syndrome. Other types of FGID have not been investigated as often. Only a few studies surveyed and classified multiple FGID at the same time in a general population. It also revealed that the prevalence of FGID varied, ranging from 61.7% in a Canadian study[4] to 36.1% in an Australian study.[5] In order to better understand the manifestations of FGID, a population-based survey was undertaken to estimate the prevalence of FGID in the Taiwanese population.

METHODS

Regular assessment of the population's nutrition and health status has become an important aspect of public health in Taiwan, and the Nutrition and Health Survey in Taiwan (NAHSIT) 2005-2008 has been carried out since 2005. The study used a stratified three-staged probability sampling design to assess the health and nutrition status of the Taiwanese, with regard to particular geographical regions, ethnic-, age- and sex groups, as well as the overall Taiwanese population. The design and sample characteristics of the NAHSIT 2005-2008 have been described in detail in the previously published article. [6] This study was approved by the Institutional Review Board from Academia Sinica and informed consents were obtained from all responders. Our survey was a part of NAHSIT 2005-2008, and utilized a standardized questionnaire to evaluate functional GI disorders. Well-trained study investigators visited the participants in a randomized manner and instructed them face-to-face on how to interpret and answer the questionnaire.

Questionnaire

The questionnaire includes multiple sets of questions, and three of them were designed to assess gastrointestinal symptoms that must be present for at least 12 weeks in the past and not regarded as pathologic. The initial setting was diagnosed using the Rome II criteria, but we modified the questions after Rome III criteria were published. The first question is about epigastralgia/epigastic discomfort in the past three months, related to bowel habit change or not. The second question focused more on recurrent abdominal pain/abdominal discomfort related to change of defecation frequency or stool consistency. Subjects that met the criteria of irritable bowel syndrome (IBS) recorded their major symptoms, such as hard stools, loose stools, strains, urgency, or abdominal distension. The third question was for functional abdominal pain, which continued for the last 3 months with some loss of daily functioning. The functional gastrointestinal disorders identified by the questionnaire included functional dyspepsia, irritable bowel syndrome, functional abdominal bloating, functional constipation, functional diarrhea, and functional abdominal pain. The response to each question included yes/quite often or rarely/not at all. Subjects were finally categorized as having functional GI disorder based on Rome III criteria.

Other sections in NAHSIT 2005-2008, including some basic data (marital status, education level, income, occupation), life styles (smoking behavior, alcohol consumption, betel nut chewing), Brief Symptom Rating Scale (BSRS-5) for screening depression and suicide ideation, and record of diet habits, were also gathered for cross-analysis.

Statistical analyses

We calculated the prevalence (n, %) of multiple functional gastrointestinal disorders according to the Rome III criteria and used SAS in weighting. The demographic and psychological associations of meeting Rome III criteria for an FGID versus not meeting Rome III criteria for an FGID were analyzed using chi-square tests for categorical variables. Significance was drawn at $p<0.05$ in a two-tailed calculation with the chi-square test.

RESULTS

Response rate and sample characteristics

In the four years- study period, a total of 4,275 responders completed the questionnaire. The sample was evenly distributed for males (n=2,137, 50.9%) and females (n= 2,138, 49.1%). The majority of subjects had a high school or lower education level (64.5%), and nearly half of the sample had low income (47.0%). Table 1 shows the basic demographic features of these responders.

Prevalence of FGID defined by Rome III criteria

Of the 4,275 responders, 993 subjects fulfilled the Rome III criteria for diagnosis of at least one FGID. The preva

Table 1. Demographic features of the study population (n=4275) †

Characteristics	n	%
Age (yr)		
19-29	676	24.1%
30-39	482	21.3%
40-49	796	21.9%
50-59	741	15.8%
60-69	669	8.47%
70-79	705	6.39%
>80	206	2.00%
Gender		
Men	2137	50.9%
Women	2138	49.1%
Marital status		
Single	638	24.8%
Married/cohabitation	2937	66.1%
Divorced/widowed	695	9.02%
Unknown	5	0.07%
Education		
≤ Junior high school	2177	32.3%
Senior high school	1136	32.2%
College	864	31.1%
≥ Master	91	4.36%
Unknown	7	0.05%
Employment		
With job	2045	60.4%
No job	2228	39.3%
Unknown	2	0.05%
Income (NTD/month) (1 NTD≈0.033 USD)		
<20000	2583	47.0%
20000-39999	850	27.6%
40000-59999	377	12.5%
60000-99999	204	6.16%
≥100000	39	1.18%
Unknown/refused to answer	222	5.57%

† All the results were weighted.

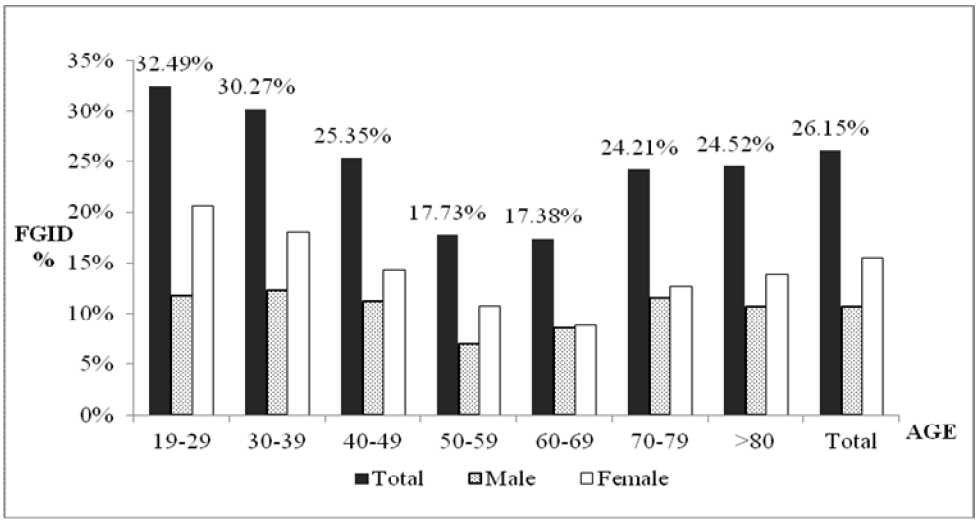

Figure 1. Sex and age distribution of the patients with functional gastrointestinal disorders

Table 2. Prevalence of FGID based on ROME III classification

Functional gastrointestinal disorders[†]	ALL (n=4275)		male (n=2137)		female (n=2138)		*p*-value [††]
	n	%	n	%	n	%	
Functional dyspepsia (B1)	193	5.3	81	4.4	112	6.3	0.027
Irritable bowel syndrome (C1)	188	4.4	77	3.4	111	5.4	0.019
Functional abdominal bloating (C2)	64	2.1	19	1.3	45	3.0	0.002
Functional constipation (C3)	198	4.4	76	2.8	122	6.2	0.001
Functional diarrhea (C4)	67	2.2	42	2.7	25	1.7	0.049
Unspecified functional bowel disorder (C5)	307	8.9	152	7.6	155	10.2	0.909
Functional abdominal pain syndrome (D)	19	0.4	7	0.2	12	0.5	0.358
Total	1036	27.7	454	22.4	582	33.2	<0.050

[†] Subjects may have more than one group of disorders. In total, 1036 functional gastrointestinal disorders were diagnosed in 993 responders. and all results were weighted.
[††] The correlation chi-square test was not weighted.

lence of FGID of the studied population was 26.2% in total. The age and sex distributions of the 993 subjects with FGID diagnosed by the Rome III Integrative questionnaire are shown in Figure 1. The ratio of total FGID patients decreased with age to 50~69 years old, and then increased with age after 70 years old. The male to female ratio of the 993 FGID patients was around 1:1.48. Women were predominantly in their 20s to 30s, and there were no obvious variability in men's age distribution.

Table 2 lists the prevalence rates of individual FGID. Of these, unspecified functional bowel disorder was the most prevalent (8.9%) and the second was functional dyspepsia (5.3%). The third FGID were irritable bowel syndrome (IBS) (4.4%) and functional constipation (4.4%). Females had a greater prevalence than males (33.2% compared to 22.4%, $p<0.05$) with regards to total FGID. Most categories of FGID were significantly prominent in female group, except for functional diarrhea. The ratio of females to males in functional dyspepsia and IBS was approximately 1.4~1.6:1, and in functional abdominal bloating and functional constipation was approximately 2.2~2.3:1. These gender differences were statistically significant ($p<0.05$). A male predominance (male: female 1: 0.6) was found for functional diarrhea, and there was no gender difference in unspecific bowel disorder groups and functional abdominal pain syndrome.

Of the 993 responders with FGID, 950 (93.97%) had a single FGID according to the Rome III Integrative Questionnaire and the remaining 43 (6.03%) subjects had multiple categories of FGID. Of the 193 functional dyspepsia patients, 37 (25.7%) overlapped with the other FGID (Table 3). The leading FGID overlapping with FD was IBS (9.5%).

Because IBS was the most well-studied FGID, the various symptoms of IBS was also examined in this study (Table 4). The leading five symptoms of IBS are presented here in descending order: distension (40.0%), feeling of incomplete evacuation (24.2%), loose and watery stools (21.5%), urgency (21.1%), and sensation that the stools cannot be passed (21.1%). It was noted that there

Table 3. FGID overlapping with functional dyspepsia

Overlapped FGID with FD[†]	n	% in total 193 FD patients
Irritable bowel syndrome	13	9.5
Functional constipation	9	8.6
Functional diarrhea	6	3.4
Unspecified functional bowel disorder	5	2.7
Functional abdominal pain syndrome	4	1.5
Total	37	25.7

[†] In total, there are 37 functional dyspepsia patients with more than one kind of FGID. All the results were weighted.

Table 4. The differences of various IBS symptoms by gender

Symptom †	Male		Female		Overall	
	n	%	n	%	n	%
<3 stools per week	4	5.3	13	17.6	17	12.7
≥3 stools per day	11	17.6	14	12.7	25	14.6
Hard stools	5	2.7	16	15.3	21	10.3
Loose and watery stools	19	28.1	20	17.2	39	21.5
Straining	8	6.8	24	25.1	32	17.9
Urgency	19	23.6	24	19.5	43	21.1
Feeling of incomplete evacuation after bowel movement	17	22.6	28	25.3	45	24.2
Passage of mucus	5	10.0	7	5.4	12	7.2
Discomfort/distension	25	38.8	35	40.7	60	40.0
Sensation that stools cannot be passed at bowel movement	13	14.8	22	23.5	35	21.1
Need to press around bottom or vagina to move stools in order to complete the bowel movement	0	0	4	5.8	4	3.5

† All the results were weighted.

Table 5. Socio-demographic associations of having a Rome III FGID versus no FGID

Sociodermographic variables	FGID (n=993)	no FGID (n=3282)	Statistics	*p* value
Mean age (SD) (years)	40.5 (16.1)	44.4 (16.1)	t=450	<0.001
Marital status (% of non-married)	41.5	31.1	χ^2=9.141	0.003
Educational level (% completed college)	38.0	34.6	χ^2=0.021	0.884
Employment (% employed)	61.2	60.1	χ^2=0.025	0.873
Income (% >20000)	48.2	47.2	χ^2=0.012	0.914

Table 6. Comparison of the population-based studies of FGID

Criteria	Thompson, Canada 2002	Boyce, Australia 2006	Chang, Taiwan (the present study)
Female: male	1.14:1	1.34:1	1.48:1
Total FGID prevalence in study	61.7%	36.1%	26.2%
Specific FGID prevalence			
Functional dyspepsia	1.8%	3.9%	5.3%
Irritable bowel syndrome	12.1%	8.9%	4.4%
Functional bloating	13.1%	4.1%	2.1%
Functional constipation	14.9%	2.8%	4.4%
Functional diarrhea	8.5%	0.1%	2.2%
Functional abdominal pain syndrome	2.7%	0.3%	0.4%
Sum of above FGID prevalence	53.1%	20.1%	18.8%

was a higher prevalence of the symptoms "<3 stools per week", "hard stools", "straining", and "sensation that the stools cannot be passed at bowel movement" in female groups.

Demographic, life habits, and psychological associations of FGID

The demographic associations of those meeting Rome III criteria for an FGID versus those who did not are shown in Table 5. There were no significant differences between these two groups regarding to education level, employment, and monthly income. But age and marital status had a significant impact on occurrence of FGID. In the FGID group, significantly younger age of these responders was noted, and the ratio of single/divorced/widow was also higher in this group. In life style survey, smoking (p=0.163), alcohol consumption (p=0.825), and betel nut chewing (p=0.632) had no significant impact on the prevalence of FGID. In dietary habits, FGID groups had fewer servings of vegetables and fruits than non-FGID group each day (vegetables 2.51 vs 2.70, p<0.001; fruits 0.82 vs.0.91, p<0.001). Only 269 responders (6.8%) ate the amount of fruits and vegetables recommended for good health (2 servings of fruit and 3 servings of vegetables each day). But there were no differences in occurrence of FGID whether the daily intake of fruits and vegetables met the recommended levels or not (p=0.97). Subjects meeting Rome III criteria for FGID scored significantly higher (mean 2.86 vs 1.63, p<0.05) on the BSRS.

DISCUSSION

This is the first population-based study in which multiple functional gastrointestinal disorders were diagnosed and classified using the Rome III criteria in Taiwan. Dr Nakajima had previously investigated the spectra of FGID in Japan with Rome II criteria in 2008 and Rome III criteria in 2010, but the study was limited in hospital outpatients. [7,8] Furthermore, our survey is also the first study to evaluate functional gastrointestinal disorders in a general population in Asia.

According to Rome III criteria, 26.2% of our study samples had at least one FGID. This is considerably lower than that reported by Thompson *et al.* who found that 62% of their sample met the Rome II criteria for having at least one FGID in Canada,[4] and Boyce *et al.* who found that 36.1% met the criteria in Australia.[5] The comparisons

of the previous two population studies with ours is presented in Table 6. The prevalence in our study is underestimated because our questionnaire only focused on three major categories of FGID: functional dysphagia (B1), functional bowel disorder (C1-C5), and functional abdominal pain syndrome (D). Some other disorders, such as functional esophageal disorders (A1-A4), functional gallbladder and sphincter of Oddi disorders (E), and functional anorectal disorders (F1-F3), were not included in our questionnaire. The prevalence of each specific disorder studied in our study was compared with the other two studies. And the sum of these disorders revealed that our prevalence in most categories of FGID was still much lower than Canadian study, but similar to the study from Australia. The reasons for these discrepancies may be the studied population. Thompson *et al*. evaluated the prevalence of all the FGID in a sample of the Canadian population who were listed on a telephone number database. [4] This may be potentially biased with low response rate (26%). Boyce *et al.* used a self-report questionnaire with a 32-page questionnaire to identify FGID. [5] The overall response rate (62.2%) was fair but the self-interpretation of the detailed items may be misunderstood. In our study, the case numbers were large and distributed covering all areas of Taiwan, and the well-trained instructors provided adequate translation and interpretation of the questionnaire face-to-face.

But most importantly, racial and cultural differences may also play important roles to account for these variations. Previous studies have reported that the prevalence of IBS varies depending on the diagnostic criteria, the geographically area in which the population is based, gender, age, and environmental factors, but have also demonstrated that IBS is quite common in the West. [9-12] The prevalence of IBS was 11.1% in the US,[13] 8.9% in Australia,[5] and 12.1% in Canada.[4] But in a Singaporean study the prevalence of IBS was 2.3%,[11] 6.6% in Korea,[14] and even 0.82% in Beijing.[15] Although lacking data for total functional gastrointestinal disorders, the Asian race or Eastern life styles may be a factor related to the lower prevalence in Taiwan's population.

In the Nakajima *et al.* study of hospital outpatients in Japan,[7,8] the top three prevalent FGID including overlapping cases was IBS, functional dyspepsia, and functional constipation, and for non-overlapping FGID was IBS, unspecified functional bowel disorder, and functional dyspepsia. Similar to the study by Nakajima, we found unspecified functional bowel disorder, functional dyspepsia, IBS, and functional constipation to be common. Compared with the previous population study using the Rome II criteria,[4,5] female predominance was also found in our study, with the ratio being around 1.48:1 (Table 6). Because this study was done for partial groups of FGID, we cannot say if these findings are universal in all categories of FGID.

In surveys of common symptoms of irritable bowel syndrome, Lee *et al*. reported that lumpy stools, bowel movement frequency, and passage of mucus were higher in women, while loose and watery stools were higher in men.[16] Thompson reported that passage of mucus, the feeling of incomplete evacuation, and distension were found to be more common in women with IBS.[17] In the present study, distension (40.0%) was the most common symptoms of IBS found in both men and women. Also, loose and watery stools, urgency, and passage of mucus were more prevalent in male subjects, whereas <3 stools per week, hard stools, straining, and sensation that the stools cannot be passed at bowel movement were more prevalent in the female groups. The manifestations of bowel symptoms varied in different studies.

In our study, significantly younger age in the FGID groups was found, though no significant differences existed in age between the FGID and non-FGID groups in the Australian study.[5] It is also unlike the age distribution of FGID patients in the Nakajima et al. study,[7,8] which revealed a dome-shape distribution, we had a V-shape age distribution in FGID responders. The reasons for these discrepancies probably reflect the representativeness of the sample used in the Nakajima *et al.* study. They evaluated the prevalence of all the FGID in patients who visited the outpatient department with symptoms possibly originating from the GI tract. Lower motivation for seeking medical evaluation in young and elderly populations may explain the high prevalence in middle-aged subjects. So from our study, we suspected that the reason for initial high FGID prevalence among young adults may be psychological factors, because they could be influenced by studying, job-seeking, or economic status. The prevalence declined to its lowest at 50-60s. But as physical status deteriorated as participants were getting older, so did the prevalence gradually increase among elderly subjects.

Among the risk factors noted for FGID, unmarried status (including those single, divorced, and widowed) had a significantly higher ratio in the FGID group. This risk factor had only been discussed in a Korea study for irritable bowel syndrome.[14] On the contrary, single/divorced status had less risk for IBS comparing with married subjects in their study, with odds ratio 0.59 (95% CI, 0.5-0.99). More studies on the difference may be needed to clarify this finding.

Different life styles, especially diet habits, play important roles in Western and Asian population studies. The high protein/fat and lower fiber intake in the diet are suspected to be the major causes of the high prevalence of FGID in Western countries. Though providing high level evidence in support of therapeutic dietary interventions is difficult because of the complexity of diet and heterogeneity of dietary intake. The effect of dietary intake on functional gastrointestinal disorder had been evaluated in some previous studies. The lower intake of vegetables and fruits may associate with constipation in Taiwanese children. [18] Short term period of kiwifruit consumption can improve bowel function in adults diagnosed with IBS constipation subtypes.[19] But fructose and fructans are also dietary triggers for symptoms of IBS when fructose malabsorption is present.[20] In our study, more vegetables and fruits intake seemed to provide the protection effect for occurrence of FGID. Worldwide health services now suggest at least three servings of vegetables and two servings of fruit for daily intake to improve health and decrease the metabolic syndrome. Quite few responders could achieve the recommendation, and there were no differences in occurrence of FGID whether the daily intake of fruits and vegetables met the recommended levels

or not. The possibility of specific food intolerances is real and worth exploring. Diet can play a useful role if only to minimize triggering of the more bothersome symptoms. But some people may go to extremes in the control of their symptoms and maintain a poorly balanced diet that can be deficient in energy sources, which is not good for general health.[21]

Since FGID is a chronic disorder, the wax and wane symptoms must be an ignorable pressure on subjects. Our study used BSRS (brief-symptom rating scale) as a quick and simple evaluation for subjects, which is a screening instrument for depression and suicide ideation. The responders with FGID had significantly high score in BSRS, which could be interpreted as either FGID subjects were bothered by the chronic disorder and more depressed, or some stressful or depressing life styles lead to not only mental but also physical dysfunction. The actual relationship between the two needs further evaluation.

The strengths of our study include the large number of participants and the random sampling of our subjects. The responders were visited by well-trained investigators face-to-face to reduce misinterpretations of the translated questionnaire from the English Rome III criteria. The limitations of this study include the absence of the complete questionnaires for all categories of FGID, and the recall bias which in some cases have led to an underrepresentation of gastrointestinal symptoms.

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AUTHOR DISCLOSURES

Fang-Yuan Chang, Po-Hon Chen, Tzee-Chung Wu, Wen-Harn, Pan, Hsing-Yi, Chang, Shin-Jiuan,Wu, Nai-Hua, Yeh, Ren-Bin Tang, Lite Wu, Frank E. James, declare no conflict of interest.

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Original Article

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臺灣功能性腸胃道障礙的盛行率：以羅馬 III 準則為基礎的成人問卷調查

功能性腸胃道障礙(FGID)是一群無法檢查到構造上異常或病變，而必須藉由臨床上慢性或重覆出現的症狀做為診斷依據的腸胃道疾病。本研究以臺灣 2005-2008 年國民營養健康調查中 19 歲以上的受訪族群，藉由 Rome III 準則設計的問卷，對其做功能性腸胃道障礙的調查。共有 4275 個受訪者完成問卷，男女比例相當(男性 2137 人；女性 2138 人)，FGID 的盛行率約為 26.2%。以未特定功能性腸道疾病為最多(8.9%)，其次為功能性消化不良(5.3%)、腸躁症(4.4%)及功能性便秘(4.4%)。女性患有 FGID 的總比例較男性高(女性 33.2%/男性 22.4%)；除了功能性腹瀉，大多種類的 FGID 仍以女性患者較多。功能性腸胃道障礙患者每日平均攝取的蔬菜水果份數較少(蔬菜 2.51/2.70；水果 0.82/0.91)，用以評估憂鬱傾向的 BSRS 分數較高，但在抽煙、喝酒或是嚼食檳榔上則並無差異性。由此研究可知，用 Rome III 準則診斷的功能性腸胃道障礙在臺灣並非少見，而患者通常較年輕、蔬果攝取較少、有較高的心理壓力分數，且以女性居多。

關鍵字：羅馬準則、功能性腸胃道障礙、腸躁症、功能性便秘、盛行率