

Relationship between Irritable Bowel Syndrome, Worry and Stress in Adolescent Girls

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The aim of this study is to investigate prevalence of irritable bowel syndrome (IBS) among adolescents and difference in worry and stress between normal and IBS groups. Questionnaire survey was conducted at a girl's middle and high school. Students from seventh to eleventh grade participated in the examination on Rome II criteria, lifestyle and dietary habits. Worry and stress were measured with the Korean version Penn State Worry Questionnaire-Children and the Korean version Brief Encounter Psychosocial Instrument. Worry score was significantly higher in the IBS group (22.07 ± 9.38 , $P < 0.001$) than in the normal group (18.65 ± 8.99) and was higher in high school students than in middle school students ($P = 0.02$). Stress score also was higher in the IBS group than in the normal group ($P < 0.001$) and was higher in the high school girls than in the middle school ones ($P = 0.04$). Of all the lifestyle factors influencing IBS preference for fatty foods, preference for salty foods, drinking alcohol and sleeping for less than six hours a day were found to be significant. Worry and stress seem to be associated with IBS symptoms. The findings of this study draw a clue that less worry and stress will help decrease IBS symptoms.

Key Words: Irritable Bowel Syndrome; Worry; Stress

INTRODUCTION

Irritable bowel syndrome (IBS) is a common functional gastrointestinal disorder and its characteristic symptoms are chronic abdominal pain or discomfort for over three months, abdominal distension and changes in bowel habit. Its prevalence was recorded to be around 10%-15% of adults in North America and to be 6.6% of adults in Korea (1, 2). IBS affects quality of life of individuals and many efforts to determine its causes have been made. The prevalence of children is similar with that of adults and the prevalence of females is known to be two times higher than that of males (3).

IBS often occurs just after gastroenteritis, after long-term gastroenteritis, in females or with associated with psychiatric stress. Stress can aggravate IBS symptoms in some cases (4). Psychiatric factors worsening IBS are anxiety, somatizing syndrome and depression (5, 6). Brown and Barlow reported that 55% of patients have symptoms meeting criteria for at least one additional anxiety or depressive disorder (7). On the contrary, IBS was observed frequently in patients with psychiatric diseases. Some studies found that 46% of panic disorder, 29% of major depression and 19% of schizophrenia were associated with IBS (8).

Stress is psychological pressure caused by an imbalance between ones' adaptive ability and the demand in perceptive environment by individual (9). Stress is more complex and has

more social properties than worry. As normal developmental tasks, adolescents are exposed to severe stress caused by competition in relation to university entrance examination and academic performance. Especially Korean adolescents are under a lot stress and pressure because they have to culturally face a fierce competition in relation to the entrance examination. Most of psychiatric stress of adolescents is attributed by academic performance and career searching, which can be presented as anxiety, worry, depression and physical symptoms associated with them (10). These worries are known to be a critical symptom of generalized anxiety disorder or one of anxiety disorders (11).

On the other hand, worry is a generalized psychological phenomenon that can be seen among most people. Borkovec et al. (12) defined that worry is a chain of thoughts and images, negatively affect-laden and relatively uncontrollable. The worry process represents an attempt to engage in mental problem-solving on an issue whose outcome is uncertain but contains the possibility of one or more negative outcomes; Consequently, worry relates closely to the fear process. However, because worry in adolescents has been recognized as a relatively timid psychological phenomenon which is commonly experienced, it has not been dealt as a main topic of a certain study. But, many studies reported that when worry became severe not to be controlled, they could influence daily life and ultimately lead to an

anxiety disorder (13, 14).

According to a study of Muris et al. (15) conducted with community children without anxiety disorder, about 6.7% showed an excessive worry exceeding the normal range and some of them had symptoms to be diagnosed as generalized anxiety disorder. According to another previous research, it reported that about 30% of normal group with no experience of psychological treatment showed a high level of worry (16). Like this, worry is a symptom to which we should pay attention but there has been nearly no study on correlation between IBS and worry. A recent study of Son et al. (17) reports that high school girls with IBS recorded higher anxiety score than those without it. Both in population and in clinical samples, women are almost twice as likely as men to meet diagnostic criteria for IBS (18, 19). Therefore, this study investigates prevalence of IBS and correlation among worry, stress and IBS with students in a girls' middle school and a girls' high school.

MATERIALS AND METHODS

Subjects

Questionnaire survey was performed in a girls' middle school and a girls' high school located in Gyeonggi-do, Korea. In Korea, students graduating an elementary school enter into a middle school and those graduating a middle school enter into a high school. Middle school and high school correspond to seventh to ninth grade and tenth to twelfth grade in the USA, respectively. Among those students, high school seniors, twelfth grader girls, were excluded in this study due to the college entrance examination. The homeroom teachers gave out the questionnaires to 827 girls. Then the teachers collected questionnaires the next day. Researchers obtained agreement of the principles and the vice-principles of the two schools after explaining them the purpose of this study by visiting the schools and sent official notes to the students and their parents to ask whether they agreed to participate in this study. The purpose of the study was described on the first page of the questionnaire to reflect the opinion of students by making them fill in it voluntarily and directly by themselves. The purpose of the study was noted, but the hypothesis was not revealed. By excluding copies of questionnaire without answers to the questions asking basic personal data, lifestyle, dietary habit and diagnosis criteria of IBS, the data of 820 students were finally analyzed.

Diagnostic assessment

A questionnaire was developed based on Rome II criteria which was most widely used for diagnosis of IBS (20). It included questions about personal data, patterns of defecation according to Rome II criteria, history of disease, family history, lifestyles, frequency and time of exercise, worry and stress.

Definition of IBS

Rome II criteria are based on actual symptoms of patients and are very useful for diagnosis with relatively higher specificity compared to other ones (21). With Rome II criteria, IBS is diagnosed when abdominal pain or discomfort continues for at least 12 weeks and two of following three symptoms are observed: (A) symptoms are relieved after defecation; (B) occurrence of symptoms is related with changes in frequency of defecation; and (C) occurrence of symptoms is related with changes in shape of stool.

Dietary habits and lifestyles

The questionnaire was developed by including 11 questions about dietary habits and lifestyles which were considered to affect IBS from many reports (22). The subjects answered the average for the last one year. Questions about dietary habits asked regular diets, frequency of meals for a day, frequency of dairy product intake, frequency of fruit intake, salty food intake and fatty food intake, and those about lifestyles asked alcohol drinking, smoking, regular exercise and time for it and hours of sleep per day.

Socioeconomic status (SES)

The subjects were classified according to Hollingshead index based on occupation and educational status of parents (23). Their occupation and educational status were divided into five groups, respectively and the lowest level group and the highest level groups scored zero and four points, respectively. According to the sum of the scores, they were classified into four SES groups from the lowest level group (I) recording 0-4 points to two groups recording 5-8 and 9-12, respectively and to the highest level group (IV) recording 13-16 points.

Body mass index (BMI)

Height and body weight were measured and BMI was calculated with them. Based on growth curve of Korean adolescents reported in 2007 the subjects of less than 85%, 85% to less than 95% and 95% or more than 95% were classified into normal, overweight and obese groups, respectively (24).

Worry

The degree of worry was examined with Korean version Penn State Worry Questionnaire for Children (PSWQ-C). PSWQ-C developed to use for adolescents and children by Chorpita et al. was reversely translated by Kang et al. (25, 26) by following the recommended guidelines of Guilleman et al. (27) and Beaton et al. (28) and its confidence in Korean elementary school children was proven with Cronbach's α of 0.92 (26). Its score range from 0 to 42 and higher score means severe worry.

Stress

Stress was investigated with Korean version Brief Encounter Psychosocial Instrument (BEPSI). The questionnaire was invented by Yim et al. and its confidence was proved with Cronbach's alpha of 0.71 (29). It is a self-report tool for patients to report their degree of stress and consists of total five questions. Patients answer them with 1 point (always) to five points (never) to describe their symptoms and the average of the total scores is used as their stress score. According to the score the subjects were divided into three groups of mild, moderate and severe stress groups.

Statistical analysis

All statistical analysis was performed with the statistical package for social sciences (SPSS) version 12.0 for Window's in this study. To investigate general characteristics of subjects, chi-square test was utilized and to determine correlation worry, stress and IBS Student t-test and ANOVA were used. A *P* value of less than 0.05 was considered to be statistically significant.

Ethics statement

This study was approved by institutional review board (IRB) of St. Vincent's Hospital and performed in accord with currently accepted ethical and safety guidelines (VC09EISI0020). We received the approval from IRB that we did not need an informed consent.

RESULTS

General characteristics of IBS patients

Of a total of 827 students, 820 (99.2%) students answered to these questionnaires and among them 105 (12.8%) met the di-

agnosis criteria of IBS. As the rates of IBS in middle school and high school girls were 35 (8.5%) of 411 and 70 (17.1%) of 409, respectively, there was a significant difference between the two groups ($P < 0.001$) (Table 1). For SES the prevalence was significantly higher in SES I group by recording 20%, but other groups did not show any significant difference.

Dietary habits and lifestyle

In relation to the nine questions about dietary habits and lifestyle, the groups liking fatty foods ($P < 0.001$), liking salty foods ($P = 0.034$), drinking alcohol ($P = 0.014$) and sleeping for less than six hours a day ($P < 0.001$) recorded significantly higher prevalence of IBS. On the contrary, regular exercise, smoking and fruit and milk intake and regular meals did not produce any significant difference compared to the normal group (Table 2). When worry and stress scores were compared according to sleep time, the worry score of the group sleeping for less than six hours a day (20.16 ± 9.14) and that of the group sleeping for over six hours a day (18.80 ± 9.05) were similar ($P = 0.126$). Multivariate regression analysis revealed that sleeping for less than six hours a day and liking fatty foods were independently related with prevalence of IBS (Table 3).

Correlation between IBS and worry

PSWQ-C score was significantly higher in the IBS group than the normal group ($P < 0.001$) (Fig. 1). In comparison between middle school and high school students, PSWQ-C score of high school girls was significantly higher than that of middle school students ($P = 0.001$), and comparison of worry score by grade did not find any significant difference but the score tended to be higher in the upper grades ($P = 0.064$) (Fig. 2).

Table 1. Comparison of general characteristics between two groups

Characteristics	Total No. (%)	With IBS No. (%)	Without IBS No. (%)	Chi-square	<i>P</i> value
Grade					
7th	148 (18.0)	8 (5.4)	140 (94.6)	20.20	< 0.001
8th	147 (17.9)	13 (8.8)	134 (91.2)		
9th	116 (14.1)	14 (12.1)	102 (87.9)		
10th	200 (24.4)	41 (20.5)	159 (79.5)		
11th	209 (25.5)	29 (13.9)	180 (86.1)		
BMI					
< 85th%	602 (91.8)	77 (12.8)	525 (87.2)	0.03	0.98
≥ 85th%, < 95th%	37 (5.6)	5 (13.5)	32 (86.5)		
≥ 95th%	17 (2.6)	2 (11.8)	15 (88.2)		
SES					
SES I	10 (1.5)	2 (20.0)	8 (80.0)	0.72	0.87
SES II	124 (18.3)	16 (12.9)	108 (87.1)		
SES III	434 (64.0)	51 (11.8)	383 (88.2)		
SES IV	110 (16.2)	13 (11.8)	97 (88.2)		
BEPSI-K					
Mild	318 (38.9)	20 (6.3)	298 (93.7)	32.28	< 0.001
Moderate	140 (17.1)	12 (8.6)	128 (91.4)		
Severe	360 (44.0)	73 (20.3)	287 (79.7)		

IBS, Irritable Bowel Syndrome; BMI, Body mass index, weight in kilogram divided by height in meters squared; SES, Socioeconomic status by the Hollingshed index; BEPSI-K, Brief Encounter Psychosocial Instrument (BEPSI), Korean version.

Table 2. Comparison of dietary and lifestyle variables between two groups

Variables	Categories	Total No. (%)	With IBS No. (%)	Without IBS No. (%)	Chi-square	P value
Exercise	Almost	249 (30.4)	33 (13.3)	216 (86.7)	2.38	0.304
	Never					
	Irregular	333 (40.6)	36 (10.8)	297 (89.2)		
Duration of sleep	Regular	238 (29.0)	36 (15.1)	202 (84.9)	12.46	< 0.001
	< 6 hr	128 (16.0)	29 (22.7)	99 (77.3)		
	≥ 6 hr	670 (84.0)	75 (11.2)	595 (88.8)		
Alcohol	Yes	38 (4.7)	10 (26.3)	28 (73.7)	6.96	0.014
	No	778 (88.2)	92 (11.8)	686 (88.2)		
Smoking	Yes	21 (2.6)	3 (14.3)	18 (85.7)	0.06	0.80
	No	796 (97.4)	99 (12.4)	697 (87.6)		
Meals	Regular (3 times/d)	525 (64.0)	62 (11.8)	463 (88.2)	1.30	0.255
	Irregular	295 (36.0)	43 (14.6)	252 (85.4)		
Salty food	Preferred	401 (49.3)	61 (15.2)	340 (84.8)	3.71	0.034
	Not preferred	412 (50.7)	44 (10.7)	368 (89.3)		
Fatty food	Preferred	389 (48.0)	76 (19.5)	313 (80.5)	32.934	< 0.001
	Not preferred	422 (52.0)	26 (6.2)	396 (93.8)		
Dairy food	Over 1/d	144 (18.2)	20 (13.9)	124 (86.1)	0.12	0.732
	Almost never	647 (81.8)	83 (12.8)	564 (87.2)		
Fruits	Daily	213 (26.2)	24 (11.3)	189 (88.7)	0.87	0.646
	2-3 times/wk	328 (40.3)	46 (14.0)	282 (86.0)		
	Almost never	272 (33.5)	35 (12.9)	237 (87.1)		

IBS, irritable bowel syndrome.

Table 3. Multivariate logistic regression analysis to evaluate risk factors of IBS (n = 782)

Variables	Odds ratio	95% CI	P value
Sleep			
≥ 6 hr	1.00		
< 6 hr	2.22	1.32-3.75	0.003
Alcohol			
No	1.00		
Yes	1.77	0.78-4.00	0.171
Salty food			
Not preferred	1.00		
Preferred	1.079	0.68-1.70	0.746
Fatty food			
Not preferred	1.00		
Preferred	3.19	1.94-5.24	< 0.001
BEPSI-K			
Mild	1.00		
Moderate	0.88	0.39-1.98	0.746
Severe	2.54	1.47-4.39	0.001

P value by Multivariate logistic regression. IBS, Irritable Bowel Syndrome; BEPSI-K, Brief Encounter Psychosocial Instrument (BEPSI), Korean version.

Correlation between IBS and stress

According to the average of five questions of BEPSI-K the subjects were classified into mild-stress, moderate-stress and severe-stress groups with less than 1.7 points, 1.7-2.1 points and over 2.1 points, respectively (29). The IBS group showed higher stress score ($P < 0.001$) and the prevalence of IBS was significantly higher in the severe stress group than in the mild stress group by recording 20.3% and 6.3%, respectively (Table 1). Comparison between middle school and high school girls found that the stress score of high school students was higher than that of middle school ones ($P = 0.009$), and comparison by grade revealed that upper grades tended to be associated with severe

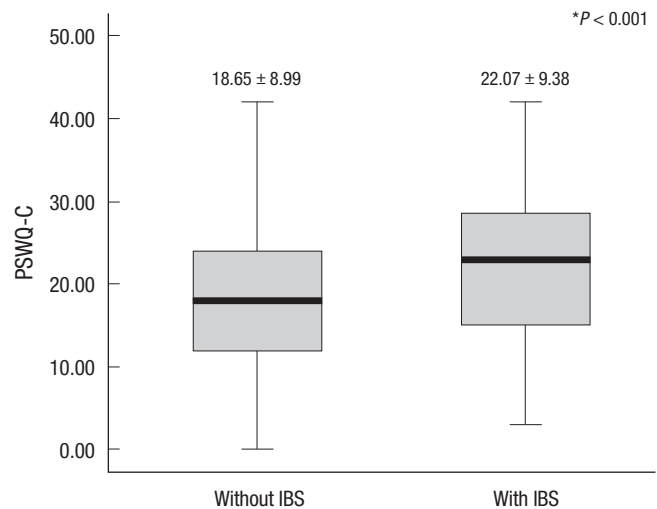


Fig. 1. Comparison of Penn State Worry Questionnaire for Children (PSWQ-C) score between two groups. *P value by t-test.

stress score although the difference was not statistically significant ($P = 0.056$) (Fig. 2). Multi-variate regression analysis showed that severe stress was independently related with prevalence of IBS. In particular, its odd ratio was 2.54 for severe stress to mild stress group (95% CI 1.47-4.39) (Table 3).

DISCUSSION

Keefer et al. (30) said that although patients diagnosed with IBS were found not to be highly anxious, they reported high levels of intolerance of uncertainty, which is a construct found to be highly related to worry. In addition, they also showed that worry

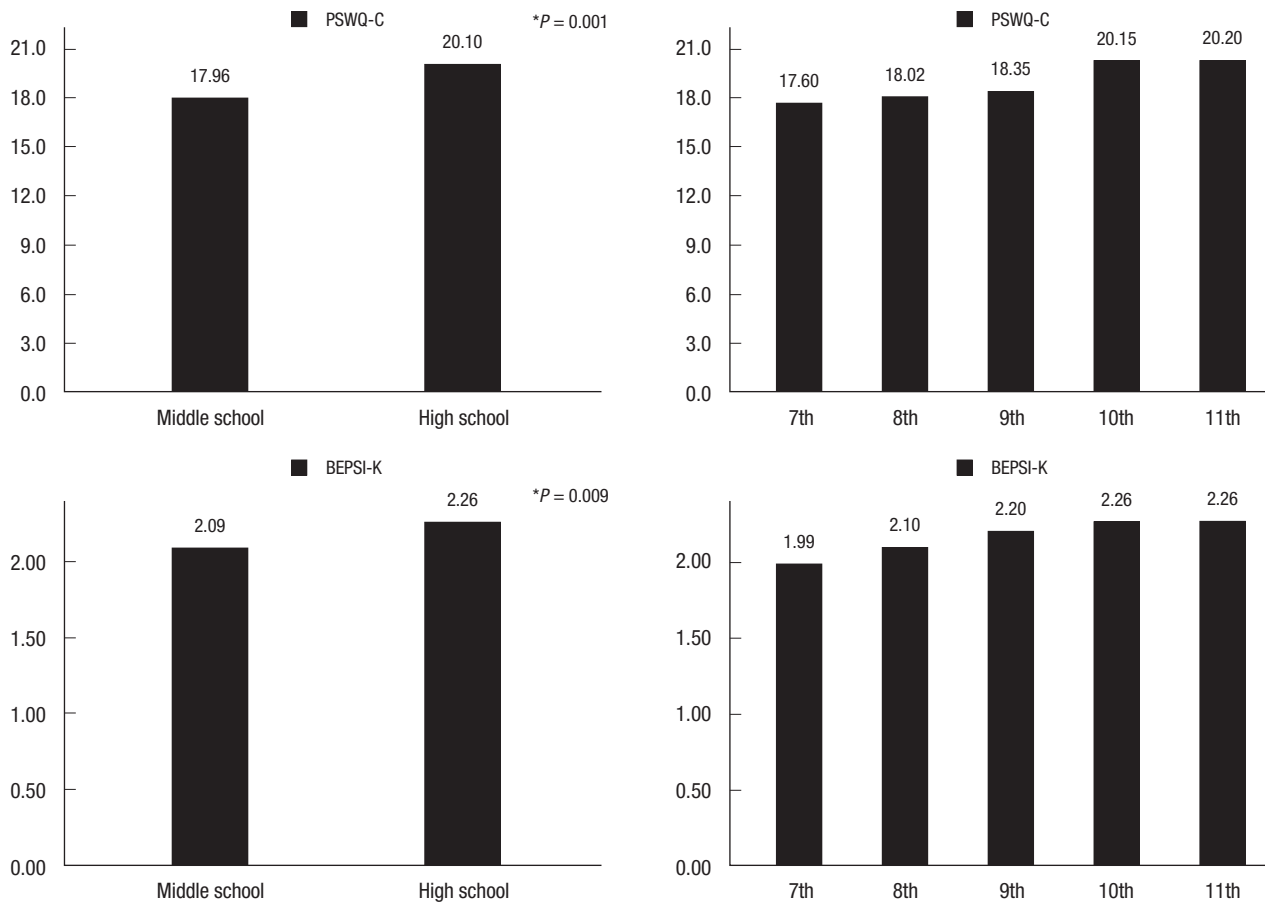


Fig. 2. Penn State Worry Questionnaire for Children (PSWQ-C) score and Brief Encounter Psychosocial Instrument-Korean version (BEPSI-K) score according to grades. **P*, by t-test.

and state anxiety were proved to be good predictors of GI symptom severity, accounting for almost 30% of the variance. They suggest that worry may be an important factor in the onset and/or maintenance of IBS. IBS patients and chronic worriers tend to devote higher levels of attentional resources toward monitoring threatening information and tend to perceive themselves as more vulnerable to disease (31-34). Unfortunately, the mechanism by which worry works in developing or maintaining IBS has yet to be elucidated.

IBS is one of functional gastrointestinal disorder occurring without an organic cause. As its symptoms are nonspecific and subjective, it is diagnosed by excluding other organic diseases. Studies to explain its mechanism have been researched and its pathologic mechanism is explained with brain-gut disorder although it is not clearly confirmed (4). Disorder of serotonin regulation cause changes of gastrointestinal movement and imbalance of absorption and secretion, and following abnormality of intestinal motility is considered to lead to abdominal pain and discomfort. In addition, not only changes of immune response and intestinal flora but also other various causes have been known to influence the complex gastrointestinal movement. So bowel hypersensitivity, brain-gut disorder and psychiatric and

social factors have been recognized as possible mechanism (4, 6, 35).

Also in this study, students with IBS had a significantly higher stress score and anxiety score as well, which implies that mental stress or excessive worry could affect occurrence of IBS. In the case of the anxiety disorder, the hyperactivity of the central norepinephrine system or the abnormal activation of serotonin or GABA receptors acts upon it (7, 36, 37). Such neurotransmitters may cause motility disorder in the gastrointestinal system or abnormal susceptibility, which indicates a possibility that stress or excessive worry may increase the imbalance among neurotransmitters in the central nervous system and as a result IBS may occur. According to several reports, patients with IBS who were trained for cognitive behavior therapy were able to control the symptoms of stress and anxiety including schoolwork-related problems (38) and relaxation therapy such as meditation, which is helpful to relieve such symptoms (39). Thus, such therapies are expected to be applied to students. In addition, there is a need to formulate an effective plan to relieve the schoolwork stress for the upper grade students who tend to have a higher stress score and anxiety score.

In this study, the incidence rate of IBS reached 8.5% and 17.1%

in middle school students and high school students respectively. The incidence rate in middle school students was similar to the rate reported in other studies. But in the case of high school students, it was lower than other studies (19.1 to 25.7%) (17, 22). It may be because the data of high school seniors were excluded from this study. If the data was included, the results may be similar to those of other studies.

Out of demographic characteristics, lower SES was associated with higher prevalence of IBS, but this study was not thought to reflect the difference in IBS prevalence by SES because the number of students included in SES I group was only ten students. Large-scale studies could investigate the prevalence according to SES more accurately.

This study examined prevalence of IBS by subdividing lifestyle factors among risk factors of IBS and found that the groups sleeping for less than six hours a day, liking salty foods and liking fatty foods recorded significantly higher prevalence. According to a study of Lee et al. in 2007, the subjects sleeping for more than six hours a day were found to be more vulnerable to IBS and they reported that the reason was because more sleep time led to less physical activity (22). However, in this study the group sleeping for less than six hours a day showed higher IBS prevalence and recorded higher worry and stress scores. As described before, it was well known that worry and stress were followed by imbalance of neurotransmitters (7, 37). Such imbalance of various neurotransmitters related with worry and stress was considered to work to provoke both of sleep disturbance and occurrence of IBS. The questionnaire used in this study asked only sleep time, so it could not evaluate the quality of sleep. If future study examines the quality of sleep, it will help to assess correlation between sleep disturbance and IBS.

For alcohol-drinking and smoking which have been known to affect gastrointestinal symptoms among lifestyles, the group not drinking alcohol showed a significantly lower prevalence. However, in multivariate regression analysis alcohol-drinking was found not to affect prevalence IBS as an independent variable. That was considered to be because the alcohol-drinking rate was only about 5% not to reflect its effect on the occurrence of IBS and because the subjects might not answer frankly the question about alcohol-drinking which was not allowed. Alcohol-drinking rate and smoking rate of the total subjects of this study were 4.7% and 3%, respectively and the levels were different from those of the survey performed by the Ministry of Health and Welfare in 2007 or 33.6% and 7.9%, respectively. As this study excluded boys, the rates of subjects including male students were expected to become higher to be similar with those of previous reports.

As limitations of this study, it investigated only preference of dietary factors which could influence IBS. Because it did not quantify actual intake, it could not consider the absolute actual intake of the subjects. If a questionnaire survey on an accurate

diet is conducted, its results will help to provide appropriate countermeasures through improvement of dietary habits. Second, although it evaluated correlation of IBS with various variables such as lifestyle factors, worry and stress, it could not determine their causal relation because it was a cross-sectional study. Lastly, this study excluded boys and third grade high school girls. Prevalence of IBS of females was reported to be two times higher than that of males and the degree of worry and stress were done to be severer in females than in males, but studies on boys experiencing same stress due to college entrance examination were also considered to be necessary.

Korean adolescents' worries and stress caused by college entrance examination and social expectation can be presented eventually as physical symptoms and especially as IBS or one of gastrointestinal symptoms largely influenced by alterations in the neurotransmitters which are involved in the brain-gut axis. The findings of this study draw a clue that less worry and stress will help decrease IBS symptoms. Additional studies on activities to reduce worry and stress like relaxation therapy and meditation and on improvement of IBS symptoms will make their application to adolescents easier.

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