

## Association between Sleep Disturbances and Abdominal Symptoms

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### Abstract

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**Objective** Although gastroesophageal reflux disease (GERD) is known to cause sleep disturbances, the relationships between other abdominal symptoms and sleep disorders have not been clarified. In the present study, we examined the relationships between daytime sleepiness and various abdominal symptoms in a non-clinical population.

**Methods** We enrolled 2,936 subjects who visited Matsue Red Cross Hospital for an annual health check examination during a 10-month consecutive period after excluding those with organic gastrointestinal diseases. The Izumo scale abdominal symptom and Epworth Sleepiness Scale (ESS) questionnaires were employed to evaluate the presence of abdominal symptoms and daytime sleepiness.

**Results** Among the 2,936 subjects, 233 (7.9%), 254 (8.6%) and 528 (18%) had GERD-like, functional dyspepsia (FD)-like and irritable bowel syndrome (IBS)-like symptoms, respectively. The ESS scores in the subjects with GERD-, FD- and IBS-like symptoms were significantly higher than those observed in the asymptomatic subjects. The subjects with multiple abdominal symptoms tended to have higher ESS scores than those with single symptoms. A multiple logistic regression analysis revealed a younger age and the presence of FD- and IBS-like symptoms to be significant influencing factors for sleep disturbances.

**Conclusion** The presence of FD and IBS symptoms in addition to GERD symptoms exhibits a strong relationship with sleep disturbances from the viewpoint of daytime sleepiness.

**Key words:** abdominal symptoms, sleep disturbance, Izumo scale, Epworth Sleeping Scale

(Intern Med 53: 2179-2183, 2014)

(DOI: 10.2169/internalmedicine.53.2591)

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### Introduction

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Good sleep is considered to be important for the quality of life, and many pathological conditions, including mental stress, are known to decrease the quality of sleep. Patients with gastroesophageal reflux disease (GERD) are reported to have a decreased quality of sleep due to heartburn and/or acid regurgitation disturbances (1, 2). Indeed, treatment of GERD with the administration of a proton pump inhibitor (PPI) has been shown to improve not only reflux symptoms,

but also sleep quality (3-6). However, the effects of abdominal symptoms other than heartburn and acid regurgitation on sleep have not been thoroughly investigated. Recently, dyspepsia was reported to decrease sleep quality, similar to reflux symptoms; however, information regarding other abdominal symptoms is limited (7).

In order to investigate the relationship between sleep disturbances and abdominal symptoms, including reflux symptoms, upper abdominal pain, fullness, constipation and diarrhea, we evaluated the results of self-reported questionnaires completed by subjects who underwent an annual health

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Received for publication January 30, 2014; Accepted for publication April 24, 2014

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**Izumo scale for abdominal symptom-related QOL**

Please check  the most appropriate box for each question based on your most recent one-week daily activities.

		Not bothered	Not so bothered	Slightly bothered	Bothered	Strongly bothered	Intolerably bothered
Q1	Are you bothered by acid reflux?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2	Are you bothered by heartburn centered in the anterior chest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3	Are you bothered by throat discomfort?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4	Are you bothered by epigastric pain?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q5	Are you bothered by hunger epigastric pain?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q6	Are you bothered by an epigastric burning sensation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q7	Are you bothered by early satiation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q8	Are you bothered by post-prandial long-lasting epigastric fullness or nausea?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q9	Are you bothered by epigastric bloating?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q10	Are you bothered by a feeling of incomplete defecation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q11	Are you bothered by constipation or hard stools?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q12	Are you bothered by stress-related constipation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q13	Are you bothered by fecal urgency?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q14	Are you bothered by diarrhea or soft stools?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q15	Are you bothered by stress-related diarrhea?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Figure 1.** Izumo scale, designed to determine abdominal symptom-related quality of life impairment.

check examination.

## Materials and Methods

This study was approved by the ethics committee of Matsue Red Cross Hospital. All subjects who visited the Department of Preventive Medicine of Matsue Red Cross Hospital for an annual health check examination between August 2011 and May 2012 were enrolled. After obtaining written informed consent for enrollment into the study, a precise medical history was taken. Individuals being treated with drugs that influence abdominal symptoms, such as PPIs, were excluded from this study, as were those with a history of major abdominal surgery. All subjects were examined using hematological and biochemical blood tests, abdominal ultrasonography, upper gastrointestinal barium meal studies or endoscopy and fecal occult blood tests. Individuals who showed any abnormal findings on these studies that may induce abdominal symptoms were not included in the study.

### Izumo scale

The Izumo scale, a self-reported questionnaire of abdominal symptoms developed and validated by our group (8-10), was employed in this study (Fig. 1). This scale contains items for 15 symptoms in five domains: Reflux, Upper ab-

How likely are you to doze off or fall asleep in the situations described in the box below, in contrast to feeling just tired?

This refers to your usual way of life in recent times.

Even if you haven't done some of these things recently, try to work out how they would have affected you.

Use the following scale to choose the most appropriate number for each situation:

0 = Would never doze  
1 = Slight chance of dozing  
2 = Moderate change of dozing  
3 = High change of dozing

Situation	Chance of dozing
Sitting and reading	
Watching TV	
Sitting, inactive in a public place (e.g. a theatre or a meeting)	
As a passenger in a car for 1 hr without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in the traffic	

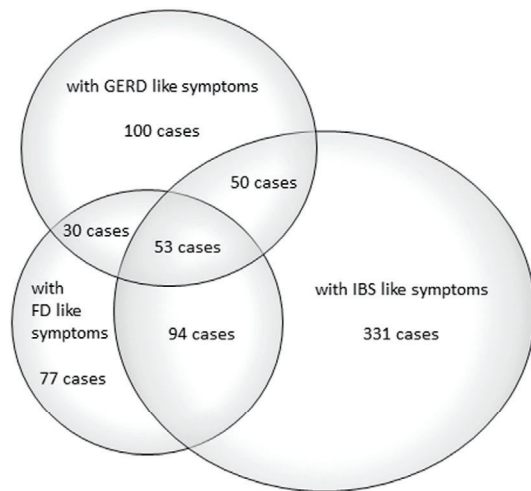
**Figure 2.** Epworth Sleepiness Scale.

dominal pain, Fullness, Constipation and Diarrhea. The answers are rated on a six-point Likert scale from 0 to 5, with higher values indicating a more severe impact on daily functioning. Each question is grouped into one of the five domains, with questions 1, 2 and 3 grouped into the Reflux domain, questions 4, 5 and 6 grouped into the Upper abdominal pain domain, questions 7, 8 and 9 grouped into the Fullness domain, questions 10, 11 and 12 grouped into the Constipation domain and questions 13, 14, and 15 grouped into the Diarrhea domain. This questionnaire has been shown to have good internal consistency and reproducibility, as well as correlation with a visual analogue scale of abdominal symptoms, the Gastrointestinal Symptom Rating Scale (GSRS) (8, 9).

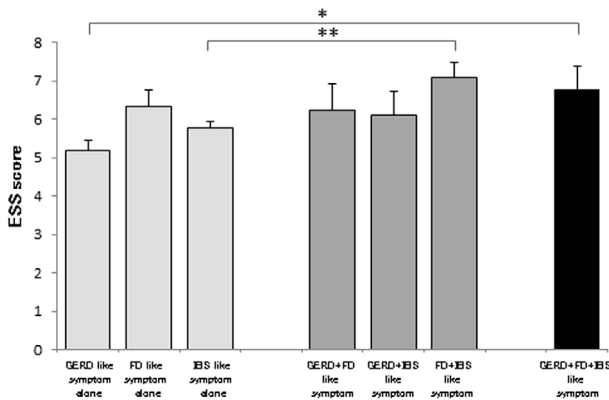
When a subject recorded a score ranging from 3-5 on the Likert scale in response to a question, they were considered to have the related symptom (10). When at least one of the symptoms in a specific domain was regarded as positive, the domain was graded as positive. In this study, both positive and negative responses in each domain were evaluated in all of the enrolled subjects.

### Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS) was developed to measure subjective sleepiness (11) and contains eight questions concerning sleepiness during common daily activities, such as watching television, on a self-reported questionnaire (Fig. 2). The Japanese version of this scale was developed



**Figure 3.** Overlap of GERD-, FD-, and IBS-like symptoms.



**Figure 5.** ESS scores in subjects with single abdominal symptom and those with multiple abdominal symptoms. Data was expressed by mean±S.E. \* $p<0.05$ , significantly different. \*\* $p<0.01$ , significantly different.

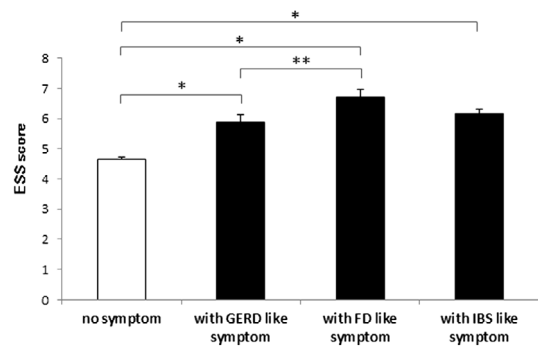
and validated in 2009 (12). Answers are scored using a four-point Likert scale from 0 to 3, with higher values indicating a more severe impact on daily functioning. The total value of all scores is taken as the ESS score. The mean ESS score for a group of normal individuals has previously been reported to be  $5.9\pm 2.2$ , while the cutoff point for sleep disturbances has been found to be between 10 and 11 (11, 12).

### Statistics

The data are presented as the mean  $\pm$  S.E. The statistical analyses were performed using the chi-square test, Kruskal-Wallis test and Mann-Whitney U-test. A multiple logistic regression analysis was also used. All calculations were performed using the Stat View 5.0 software package for Macintosh (Abacus Concepts, Berkeley, USA). Differences at a  $p$  value of  $<0.05$  were considered to be statistically significant.

## Results

We enrolled 2,936 subjects in this study, of whom 1,835



**Figure 4.** ESS scores in subjects with and without various abdominal symptoms. Data was expressed by mean±S.E. \* $p<0.001$ , significantly different. \*\* $p<0.05$ , significantly different.

were men. The mean age of the enrolled patients was  $54.8\pm 0.2$  years. Seventy-five percent of the subjects had no abdominal symptoms, while 25% had at least one symptom. Furthermore, 233 (7.9% of the enrolled subjects) patients with reflux domain symptoms were classified as having GERD-like symptoms, 254 (8.6%) with upper abdominal pain and/or fullness domain symptoms were classified as having functional dyspepsia (FD)-like symptoms and 528 (18%) with constipation and/or diarrhea domain symptoms were classified as having irritable bowel syndrome (IBS)-like symptoms. There was some overlap between the subjects with GERD-, FD- and IBS-symptoms (Fig. 3).

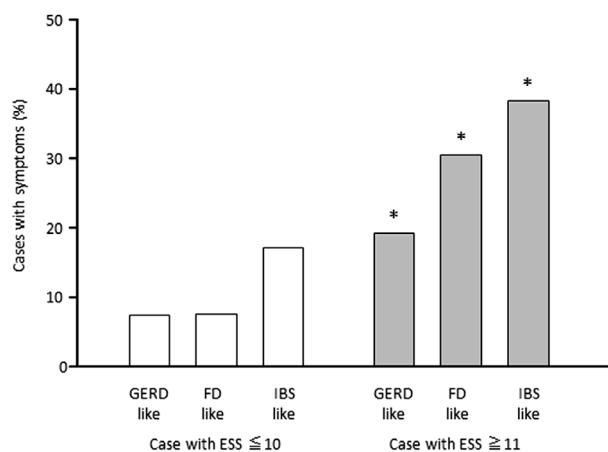
The ESS scores of the subjects with GERD-, FD- and IBS-like symptoms were significantly higher than those of the asymptomatic subjects. In addition, the ESS scores of the subjects with FD-like symptoms were significantly higher than those of the subjects with GERD-like symptoms (Fig. 4). Furthermore, the subjects with multiple abdominal symptoms tended to have higher ESS scores than those with single symptoms (Fig. 5).

The subjects were divided into sleep disturbed ( $\geq 11$  points) and undisturbed ( $\leq 10$  points) groups based on the ESS score cutoff value (11, 12). A higher percentage of subjects in the sleep disturbed group complained of GERD-, FD- or IBS-like symptoms, and the number of symptomatic subjects in the sleep disturbed group was more than double that noted in the undisturbed group (Fig. 6).

When the effects of various factors on sleep disturbances (ESS score  $\geq 11$ ) were evaluated according to the multiple logistic regression analysis, a younger age and the presence of FD- and IBS-like symptoms were found to be significant influencing factors. Further separation of FD- and IBS-like symptoms into upper abdominal pain, fullness, constipation and diarrhea clarified that upper abdominal pain and diarrhea had a significant effect on the incidence of sleep disturbances (Table).

## Discussion

Good sleep is an important factor for the quality of life



**Figure 6.** Percentage of subjects with each symptom. Among those with a high ESS score ( $\geq 11$ ), the percentage of symptomatic subjects was higher than that of asymptomatic subjects. \* $p < 0.01$ , significantly different for each symptom.

and it may be disturbed by gastrointestinal symptoms. Reflux symptoms, including heartburn and acid regurgitation, that occur during the nocturnal period have been repeatedly reported to impair sleep quality (3-6), and GERD is regarded to be a disease with nocturnal symptoms that must be completely eliminated in order to relieve sleep disturbances (13).

In the present study, the relationships between sleep disturbances and various abdominal symptoms were evaluated in subjects without organic gastrointestinal disease. Our results showed that GERD-like symptoms, such as heartburn and acid regurgitation, aggravate daytime sleepiness, as previously reported (3-5, 13). However, the presence of GERD-like symptoms was not found to have a statistically significant effect on the incidence of sleep disturbances (ESS score  $\geq 11$ ) according to a multiple regression analysis. On the other hand, the presence of FD- and IBS-like symptoms was identified to be a statistically significant risk factor for sleep disturbances (ESS score  $\geq 11$ ) in the multiple regression analysis. In addition, upper abdominal pain and diarrhea were found to be especially related to sleep disturbances. Therefore, the presence of FD- and IBS-like symptoms is considered to have a stronger relationship with sleep disturbances than reflux symptoms.

Abdominal symptoms may decrease both sleep quantity and quality via various mechanisms, including frequent nocturnal awakening (14-17). On the other hand, sleep deprivation has been reported to enhance gastrointestinal sensitivity and aggravate unpleasant abdominal symptoms (18-20). Therefore, there may exist a causal relationship between abdominal symptoms and sleep disturbances, although the mechanisms underlying this relationship are difficult to identify.

The subjects of this study included a non-clinical population without organic gastrointestinal diseases. Therefore, the abdominal symptoms observed among our study subjects are thought to be caused by functional disorders and may not

**Table.** Effects of Various Factors on Daytime Sleepiness (ESS  $\geq 11$ ) by Multiple Logistic Regression Analysis

	Odds ratio	95%CI	p value
Age	0.974	0.959-0.989	<0.001
Gender (male)	1.304	0.722-1.482	0.854
GERD-like symptoms	1.585	0.951-2.653	0.074
FD-like symptoms	3.375	2.149-5.300	<0.001
IBS-like symptoms	1.906	1.272-2.856	<0.001
Upper abdominal pain	2.603	1.527-4.440	<0.001
Fullness	1.541	0.846-2.806	0.157
Constipation	1.585	0.987-2.545	0.057
Diarrhea	1.811	1.145-2.865	0.011

have been strong enough to encourage the individuals to visit a clinic for treatment. Nevertheless, our results showed that the patients with abdominal symptoms experienced significant sleep disturbances. Therefore, the abdominal symptoms of patients treated at clinics, as well as those who do not seek treatment, are expected to worsen the quantity and quality of sleep, even though such symptoms are not caused by organic gastrointestinal diseases.

There are some limitations associated with this study. For example, the presence of a sleep disturbance was evaluated according to the ESS score only. Sleep disturbances can be assessed using different tools, such as the Pittsburgh Sleep Quality Index (PSQI) (21) or St. Mary's Hospital Sleep Questionnaire (SMH) (22). The PSQI is a composite questionnaire that evaluates the degree of sleep disturbance with a tendency to be influenced by the effects of an individual's mental state, particularly a depressive state (21), while the SMH is designed to detect sleep disturbances in inpatients and can also be affected by a depressive mental state (22). In contrast, the ESS was designed to primarily detect sleepiness in outpatients, and the questionnaire is easy to answer and can be used to detect the effects of sleep disturbances on daily life (11, 12). Therefore, we used the ESS score to evaluate the presence of sleep disturbances in our non-clinic subjects. Meanwhile, the presence of abdominal symptoms was assessed using only the Izumo scale. Although this self-reported questionnaire scale has been validated and is widely used with good reproducibility and accuracy, each questionnaire has specific characteristics (8, 9). Therefore, additional studies employing various parameters to evaluate sleep disturbances and abdominal symptoms are needed to confirm and expand our findings. Furthermore, in this study, we did not investigate several factors, such as the mental state, work schedule, environmental conditions or drinking and smoking habits of our subjects, which have been demonstrated to affect sleep (23-29). Therefore, further research is needed to confirm the effects of abdominal symptoms on sleep disturbances by analyzing several additional factors that affect sleep.

In conclusion, we found that, in addition to GERD symptom, FD and IBS symptoms have a strong relationship with the incidence of sleep disturbances from the viewpoint of daytime sleepiness.

**The authors state that they have no Conflict of Interest (COI).**

### Acknowledgement

This work was supported by a research fund from the Shimane University Faculty of Medicine.

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