

## **Supplementary Material**

### **Methods**

#### ***PSQI***

The PSQI consists of 17 items categorized under 7 sleep-related areas (i.e., components), including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. Each component score ranges from 0 to 3. The sum of these 7 component scores provides a total PSQI score, which ranges from 0 to 21.

#### ***WPAI:GH***

The WPAI is one of the most frequently used, validated, self-report questionnaires. It is designed to quantify the effect of health and symptoms on work productivity, as well as the impairments experienced during regular unpaid activities, using a 7-day recall period. The General Health version of the WPAI (WPAI:GH) provides information about the impact of health problems on the ability to work and perform regular activities. Absenteeism (percent work time missed due to health problems), presenteeism (percent impairment at work/reduced on-the-job effectiveness), overall work productivity loss (combination of absenteeism and presenteeism), and impairment of daily activities (percent activity impairment due to health problems) can be assessed.

#### ***Economic loss***

The earned wage of each participant was estimated based on the participants' employment type and age, according to the *Summary Report of Basic Survey on Wage Structure (Nationwide) 2014*, published by the Ministry of Health, Labour and Welfare in Japan. Economic loss due to the loss of work productivity was calculated by multiplying the earned wage and the loss of work productivity.

#### ***Statistical analysis***

In Study 1, the association between the presence of FD and the severity of impaired sleep quality was

analysed with and without adjustment of the severity of the other concomitant symptoms. Subsequently, the association between loss of work productivity and severity of impaired sleep quality was analysed with and without adjustment of the severity of the other concomitant symptoms in FD and non-FD participants. In Study 2, the association between the presence of FD and the severity of impaired sleep quality was validated independently.

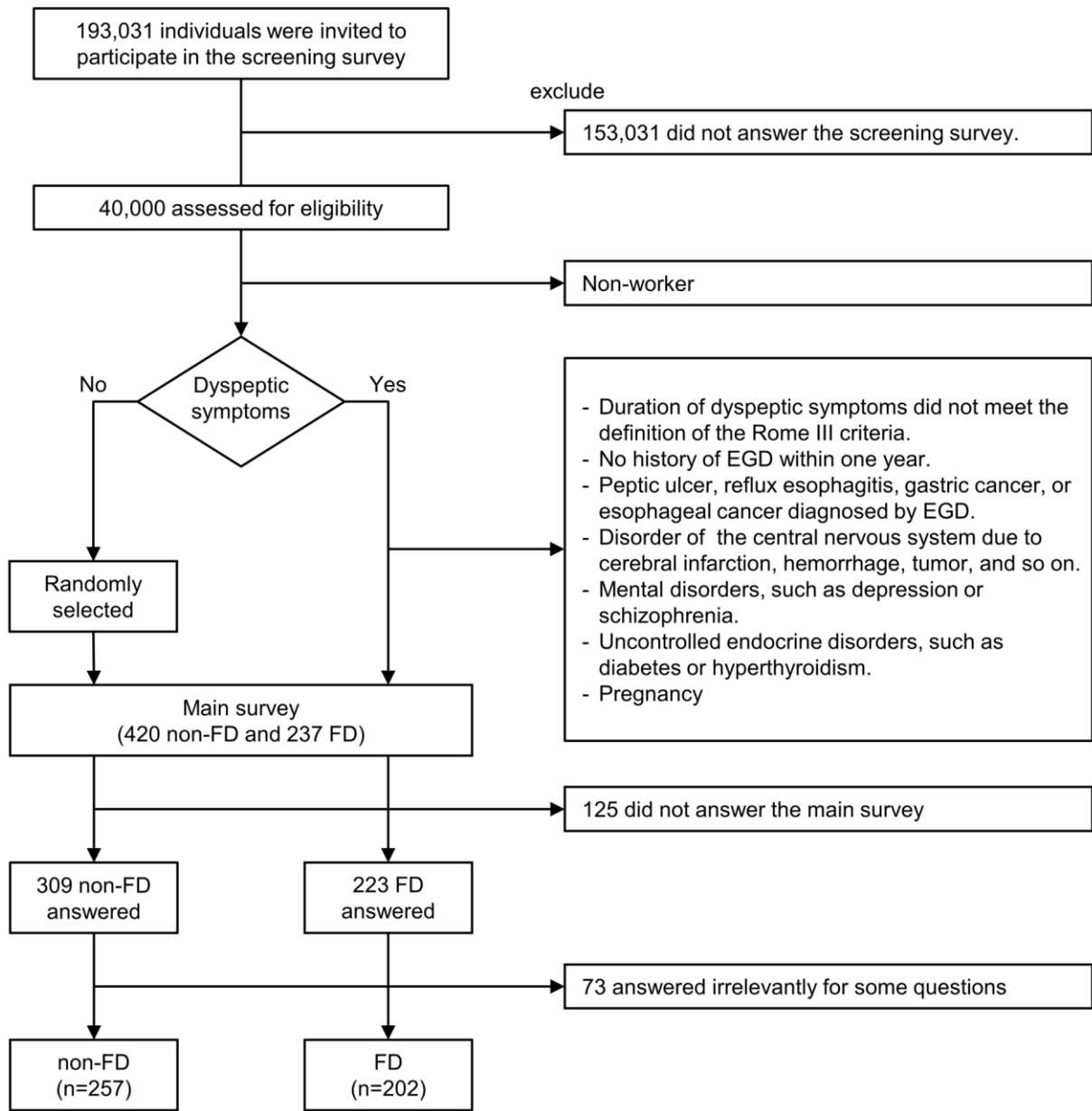
Differences between the two groups were compared using Fisher's exact test for categorical variables or Student's t-test for continuous variables. Differences among more than two groups were compared using Pearson's  $\chi^2$  test for categorical variables. Correlation among continuous variables and ordinal variables were evaluated using Pearson's correlation analysis. Univariable and multivariable logistic regression analyses were used to examine the associations of the presence of FD with the concomitant symptoms, including impaired sleep quality. Univariable and multivariable linear regression analyses were used to examine the associations of economic loss with the concomitant symptoms, including impaired sleep quality. Data were expressed as means  $\pm$  standard deviations. Two-sided p-values  $< 0.05$  were considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics 23 (IBM Corporation, NY, USA).

**Table S1. Participant characteristics (Study 2)**

	non-FD (n = 78)	FD (n = 40)	P value
Age (y) [Mean ± S.D.]	29.4 ± 16.4	49.5 ± 18.1	<0.001 †
Sex			0.01 ‡
Men	41 (52.6 %)	11 (27.5 %)	
Women	37 (47.4 %)	29 (72.5 %)	
BMI (kg m <sup>-2</sup> ) [Mean ± S.D.]	21.4 ± 4.0	19.8 ± 3.1	0.03 †
Smoking habit			0.74 §
Current smokers	6 (7.7 %)	2 (5.0 %)	
Ex-smokers	7 (9.0 %)	5 (12.5 %)	
Non-smokers	65 (83.3 %)	22 (82.5 %)	
Alcohol drinking habit			0.65 §
5-7 days/week	5 (6.4 %)	1 (2.5 %)	
1-4 days/week	18 (23.1 %)	10 (25.0 %)	
<1 day/week	55 (70.5 %)	29 (72.5 %)	
GerdQ ≥ 8	7 (9.0 %)	18 (45.0 %)	<0.001 ‡
IBS	4 (7.3 %)	10 (27.8 %)	0.02 ‡
IBS-C	0 (0 %)	4 (10.0 %)	
IBS-D	2 (2.6 %)	2 (5.0 %)	
IBS-M	0 (0 %)	1 (2.5 %)	
IBD-U	2 (2.6 %)	3 (7.5 %)	
PSQI ≥ 6	21 (26.9 %)	21 (52.5 %)	0.008 ‡
HADS-A ≥ 8	15 (19.2 %)	22 (55.0 %)	<0.001 ‡
HADS-D ≥ 8	14 (17.9 %)	12 (30.0 %)	0.16 ‡

FD, functional dyspepsia; BMI, body mass index; GerdQ, gastroesophageal reflux disease questionnaire; PSQI, the Pittsburgh sleep quality index; †, Student's *t*-test; ‡, Fisher's exact test; §, Pearson's chi-square test; HADS-A, anxiety subscale of hospital anxiety and depression scale; HADS-D, depression subscale of hospital anxiety and depression scale;

# Figure S1



**Figure S1.** Patient recruitment flowchart (Study 1)

EGD, esophagogastroduodenoscopy; FD, functional dyspepsia

# Figure S2

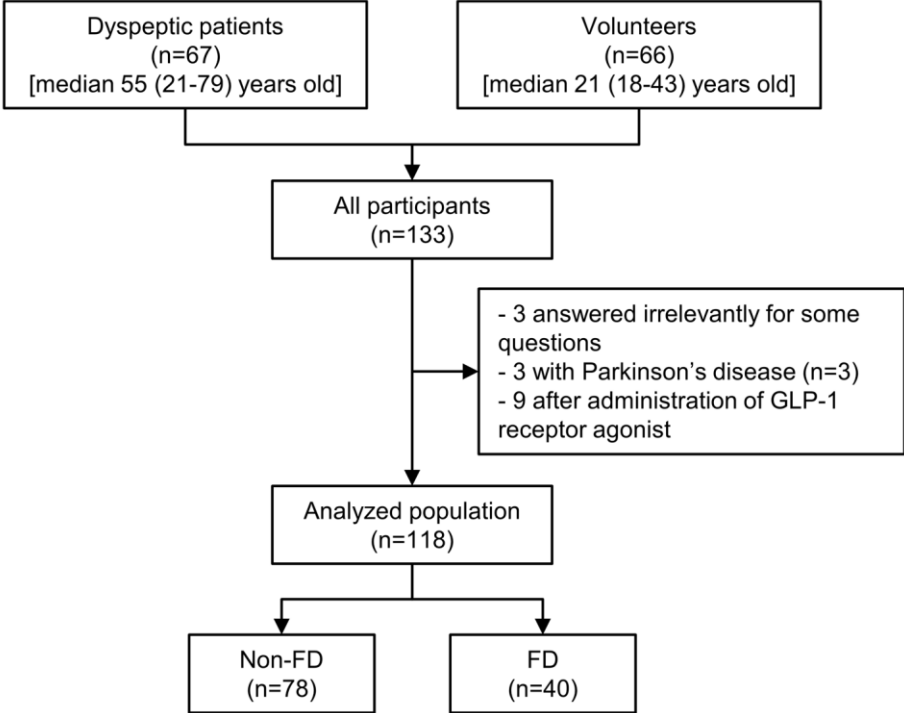


Figure S2. Patient recruitment flowchart (Study 2)

FD, functional dyspepsia