【 ORIGINAL ARTICLE 】

Effect of the Coronavirus Disease 2019 Lockdown on Lifestyle Factors in Japanese Patients with Inflammatory Bowel Disease

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Abstract:
Objective   To examine the effect of the coronavirus disease 2019 (COVID-19) lockdown on lifestyle factors and psychological stress in patients with inflammatory bowel disease (IBD).
Methods   A retrospective study was conducted on patients with IBD in Japan 2 months after the initiation of the first state of emergency (June 16 to August 21, 2020). A self-reported questionnaire was used to collect data, and lifestyle factors and psychological stress levels before and after the state of emergency were compared.
Patients   Patients with IBD who were followed up regularly at Osaka City University Hospital from June 16 to August 21, 2020, were included and were classified into elderly (≥65 years old) and non-elderly groups (< 65 years old).
Results   The study sample comprised 451 responders (241, ulcerative colitis; 210, Crohn's disease; 0, COVID-19). The sleep duration increased, whereas the exercise, working, and walking durations decreased during the COVID-19 lockdown. The proportion of patients with psychological stress due to COVID-19, those with an inability to exercise, and those staying indoors increased significantly during COVID-19 lockdown. Lifestyle factors changed more markedly in non-elderly patients, those who were more stressed due to COVID-19, those with the inability to exercise, and those staying indoors during COVID-19 lockdown. Among elderly patients, no significant changes were identified in stress-causing factors.
Conclusion   The COVID-19 lockdown affected lifestyle factors and psychological stress in patients with IBD, particularly non-elderly patients. These findings may be helpful in suggesting favorable lifestyle changes for patients with IBD.

Key words: coronavirus disease 2019, inflammatory bowel disease, ulcerative colitis, Crohn's disease, lifestyle factors, psychological stress

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Introduction

Novel coronavirus disease 2019 (COVID-19) is a severe acute respiratory syndrome caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This pathogen was first reported in Wuhan City (Hubei, China) in early December 2019 and soon spread worldwide, prompting the World Health Organization to declare COVID-19 as a global pandemic. The first case of COVID-19 in Japan was identified on January 15, 2020, and the Japanese government declared a state of emergency on April 16, 2020. The govern-

ment requested social distancing, self-isolation at home, remote working, and school closures. While these measures were necessary to protect public health, they may have radically changed individual lifestyles, leading to decreased physical activity, altered rhythm of daily life, and unhealthy lifestyles (1, 2). Previous studies on quarantined patients have revealed increased emotional disturbances, anxiety, and general stress levels, as well as a low mood (3-6). Conversely, several studies have also reported positive effects of the COVID-19 lockdown, such as enhanced communication and an increased feeling of closeness with family members (7).

Inflammatory bowel disease (IBD) includes intestinal disorders influenced by the environment (8). We previously analyzed the effects of the state of emergency due to COVID-19 on the disease activity and risk factors for disease exacerbation related to lifestyles and psychological stress. We reported that 34% of patients with ulcerative colitis (UC) and 46% of patients with Crohn's disease (CD) experienced disease exacerbation within 2 months of the declaration of a state of emergency. In addition, age, sleep hours, and stress due to the COVID-19 pandemic were identified as independent factors associated with UC exacerbation, and age and active disease before the state of emergency were identified as independent factors associated with CD exacerbation (9).

Several studies have reported lifestyle changes and increased psychological stress due to the COVID-19 lockdown, with a particular focus on age and sex differences in the general population (10-13). In patients with IBD, lifestyle factors, psychological stress, smoking habits, and drug adherence have been reported to significantly affect disease activity (14-17). Patients with UC or CD are reportedly similar regarding the presence of increased levels of anxiety and depression compared with controls, both in a "normal" situation (18) as well as during a pandemic (19). Nonetheless, there is limited evidence concerning the effect of the COVID-19 lockdown on changes in lifestyle factors and psychological stress in patients with IBD (12, 20, 21), especially in Japan. Furthermore, only a few studies have reported these changes with a particular focus on age and sex differences.

Although the acceptance of SARS-CoV-2 vaccines is becoming widespread in Japan (22), it is important to understand the changes in lifestyle and psychological stress in patients with IBD so as to provide appropriate medical care. Therefore, this post hoc analysis investigated the changes in lifestyle factors and psychological stress during COVID-19 lockdown in Japanese patients with IBD, with a particular focus on age and sex differences in order to help IBD teams deliver better patient care in the event of another pandemic wave using data from the study described above (9).

Materials and Methods

Study design and participants

This retrospective study was a post hoc analysis of our previous study (9) and was conducted using a self-reported questionnaire. In Japan, a state of emergency was declared due to COVID-19 on April 16, 2020. Our survey was conducted 2 months after the initiation of the state of emergency on patients with IBD who were followed up regularly at Osaka City University Hospital from June 16 to August 21, 2020. Patients with repeated visits were investigated only once. The exclusion criteria were as follows: a history of colostomy, ileostomy, or total proctocolectomy with ileal pouch-anal anastomosis; a diagnosis of IBD within the last three months; and an inability to complete the questionnaire despite assistance.

Questionnaire design

We conducted an anonymized survey on the COVID-19 history, demographic data (sex, age at enrollment, and age at the disease diagnosis), current gastrointestinal symptoms, medication, lifestyle factors (sleep, working, walking, and exercise durations and number of meals consumed), and psychological stress during and before the state of emergency.

Definitions

Drug nonadherence was defined as failure to take the prescribed medication at least once a week. Elderly patients were defined as those ≥65 years old. A short sleep duration was defined as a sleeping time of <7 hours, which is known to be associated with an increased risk of mortality and cardiovascular events (23, 24)

Statistical analyses

Continuous variables are presented as median and interquartile range (IQR). Differences in lifestyle factors were compared using either the chi-squared test or Fisher's exact test for categorical variables. McNemar's test was used to determine whether the discordance between two points was statistically significant. Wilcoxon's signed-rank test was used to analyze statistically significant differences between paired, continuous variables.

Statistical significance was set at $p < 0.05$. All statistical analyses were performed with EZR (Jichi Medical University, Saitama Medical Center, Saitama, Japan), a graphical user interface for R (The R Foundation for Statistical Computing, version 2.13.0). More precisely, it is a modified version of the R commander (version 1.6-3) that includes statistical functions frequently used in biostatistics.

Ethical considerations

All patients provided their informed consent. The study protocol was approved by the Ethics Review Board of the

Table 1. Demographic Data of the Participants and Their Medications.

		All patients
Demographics	Number of patients	451
	Ulcerative colitis/Crohn's disease	241/210
	Sex: male/female	287/164
	Age at enrollment (years), median (IQR)	46 (35-55)
	Age at diagnosis (years), median (IQR)	28 (20-39)
	Disease duration (years), median (IQR)	13.0 (6.0-23.5)
Medication	Mesalamine, n (%)	337 (74.7%)
	Corticosteroids, n (%)	16 (3.5%)
	Immunomodulators, n (%)	134 (29.7%)
	Anti-tumor necrosis factor therapy, n (%)	140 (31.0%)
	Ustekinumab, n (%)	26 (5.8%)
	Vedolizumab, n (%)	18 (4.0%)
	Tofacitinib, n (%)	6 (1.3%)

IQR: interquartile range

Osaka City University Graduate School of Medicine, and the study was performed in accordance with the guidelines laid down by the Declaration of Helsinki.

Results

Demographics

The study sample comprised 451 responders. Although two patients had come in close contact with confirmed COVID-19 patients and one patient had self-isolated, no cases of COVID-19 were registered in our study sample. Table 1 summarizes the demographic data of patients and their medications. A total of 241 patients were diagnosed with UC and 210 with CD. Among the respondents, 63.6% were men, and 15.3% were elderly (≥65 years old). Regarding IBD medication, the majority of patients received mesalamine [74.7% (337/451)]; corticosteroid use was limited in our study sample [3.5% (16/451)]. Overall, 29.7% (134/451) of patients were on immunomodulators, 31.0% (140/451) were on anti-tumor necrosis factor therapy, 5.8% (26/451) were on ustekinumab, 4.0% (18/451) were on vedolizumab, and 1.3% (6/451) were on tofacitinib.

A comparison of lifestyle factors and psychological stress between the pre-lockdown and lockdown periods

Table 2 presents a comparison of lifestyle factors and psychological stress between the pre-lockdown and lockdown periods. Sleep duration increased significantly during the lockdown, with a median sleep duration of 6 h/day (IQR: 6-7 h/day). As the majority of patients answered that they slept for 6-7 h, the median sleep duration did not change markedly after lockdown. The proportion of patients who slept for a short time (defined as sleep duration of <7 h) decreased significantly during the lockdown. Furthermore, the exercise duration decreased significantly, with the median duration during the lockdown being 30 min/week (IQR: 0-

120 min/week). Work and walking durations also decreased significantly, but drug adherence and the number of meals consumed did not change significantly. The proportion of patients who were stressed due to COVID-19 leaving them unable to exercise and who stayed indoors increased significantly during the lockdown (Table 2). In terms of drug adherence, the nonadherence rate did not change significantly during the lockdown, and no patients reported changing or discontinuing IBD medication due to COVID-19 infection based on their judgment. No significant differences were noted in the use of medications such as immunomodulators or steroids between patients who were stressed due to COVID-19 and those who were not stressed (data not shown).

Sex differences

The sleep duration increased, whereas work and walking durations decreased during the lockdown in both men and women. The exercise duration in men decreased significantly (p=0.017), whereas that in women did not show a significant difference (p=0.163) (Table 3). Regarding psychological stress, men felt more stressed due to the inability to exercise and having to stay indoors during the lockdown, whereas women reported psychological stress due to COVID-19 and having to stay indoors (Table 3). The drug nonadherence rate did not change significantly in men or women during the lockdown.

Lifestyle factors and psychological stress in elderly and non-elderly patients

Table 4 describes the evaluation of lifestyle factors and psychological stress in elderly and non-elderly patients in the pre-lockdown and lockdown periods. Sleep duration increased, whereas work, walking, and exercise durations decreased in non-elderly patients during the lockdown. Conversely, sleep duration decreased, and work, walking, and exercise durations remained unchanged in elderly patients. Regarding psychological stress, non-elderly patients felt

Table 2. Comparison of Lifestyle Factors and Psychological Stress before and during the Lockdown.

	Pre-lockdown	During lockdown	p value
Lifestyle			
Sleeping time			
Median (IQR) (h/day)	6 (6-7)	6 (6-7)	<0.01
<7 h/day, n (%)	258 (57.2%)	238 (52.8%)	<0.01
≥7 h/day, n (%)	193 (42.8%)	213 (47.2%)	
Working time			
Median (IQR) (h/week)	35 (0-45)	18 (0-40)	<0.01
<20 h/week	170 (37.7%)	227 (50.3%)	<0.01
20-40 h/week	73 (16.2%)	66 (14.6%)	
≥40 h/week	208 (46.1%)	158 (35.0%)	
Walking time			
Median (IQR) (h/day)	1 (1-1)	1 (0-1)	<0.01
<0.5 h/day, n (%)	83 (18.4%)	131 (29.0%)	<0.01
0.5-2 h/day, n (%)	265 (58.8%)	245 (54.3%)	
≥2 h/day, n (%)	103 (22.8%)	75 (16.6%)	
Exercise time			
Median (IQR) (min/week)	30 (0-120)	5 (0-120)	<0.01
<30 min/week, n (%)	224 (49.7%)	249 (55.2%)	<0.01
≥30 min/week, n (%)	227 (50.3%)	202 (44.8%)	
Number of meals per day, median (IQR)	3 (2.5-3)	3 (2-3)	0.480
Adequate rest, n (%)	106 (23.5%)	85 (18.8%)	<0.01
Non-adherence, n (%)	102 (22.6%)	98 (21.7%)	0.343
Stress			
Stress due to childcare burden, n (%)	41 (9.1%)	40 (8.9%)	1
Stress due to COVID-19, n (%)	105 (23.3%)	121 (26.8%)	<0.01
Stress due to family budget, n (%)	73 (16.2%)	79 (17.5%)	0.264
Stress due to inability to exercise, n (%)	128 (28.4%)	149 (33.0%)	<0.01
Stress due to staying indoors, n (%)	91 (20.2%)	121 (26.8%)	<0.01
Stress due to inflammatory bowel disease, n (%)	92 (20.4%)	91 (20.2%)	1
Stress due to worsening of diet and nutritional status, n (%)	40 (8.9%)	39 (8.6%)	1

COVID-19: coronavirus disease 2019, IQR: interquartile range

more stressed due to COVID-19, the inability to exercise, and having to stay indoors during the lockdown, whereas no significant changes were identified in stress-causing factors in elderly patients (Table 4). The drug nonadherence rate remained unchanged in both groups during the lockdown.

Lifestyle factors and psychological stress in patients with UC and those with CD

Sleep duration increased, whereas work and walking durations decreased during the lockdown in both patients with UC and patients with CD. The exercise duration in those with UC decreased significantly (p<0.05), whereas that in patients with CD did not show a significant difference (p= 0.210) (Table 5). Regarding psychological stress, patients with UC experienced more stress due to the inability to exercise and having to stay indoors during the lockdown period, whereas patients with CD reported psychological stress due to COVID-19 and having to stay indoors (Table 5). The drug nonadherence rate did not change significantly between patients with UC and patients with CD during the lockdown

period.

Discussion

This study evaluated the impact of the COVID-19 lockdown on lifestyle factors and psychological stress in Japanese patients with IBD, with a particular focus on sex and age differences. The principal finding was that the COVID-19 lockdown altered lifestyle factors and worsened psychological stress in all patients, especially non-elderly patients.

An association between IBD and lifestyle factors, such as sleep or exercise duration, has been reported (25, 26). Sleep disturbance is commonly found in patients with active IBD (27, 28) and has been reported to increase the risk of exacerbation of CD symptoms, although this has not been reported for UC symptoms (14). Yu et al. reported that reduced exercise was a risk factor for worsening IBD (29). Psychological stress has also been reported to increase the risk of exacerbations in patients with IBD (30, 31).

Various studies have assessed the impact of the COVID-

Table 3. **Comparison of Lifestyle Factors and Psychological Stress in Males and Females between Pre-lockdown and Lockdown Periods.**

	Males (n=287)			Females (n=164)		
	Pre-lockdown	During lockdown	p value	Pre-lockdown	During lockdown	p value
Lifestyle						
Sleeping time						
Median (IQR) (h/day)	6 (6-7)	6 (6-7)	<0.01	6 (6-7)	7 (6-7)	<0.05
<7 h/day, n (%)	172 (59.9%)	160 (55.7%)	<0.01	86 (52.4%)	78 (47.6%)	0.061
≥7 h/day, n (%)	115 (40.1%)	127 (44.3%)		78 (47.6%)	86 (52.4%)	
Working time						
Working time (h/week), median (IQR)	40 (14-48)	32 (0-45)	<0.01	11.5 (0-40)	0 (0-21.8)	<0.01
<20 h/week	83 (28.9%)	111 (38.7%)	<0.05	87 (53.0%)	116 (70.7%)	<0.01
20-40 h/week	38 (13.2%)	45 (15.7%)		35 (21.3%)	21 (12.8%)	
≥40 h/week	166 (57.8%)	131 (45.6%)		42 (25.6%)	27 (16.5%)	
Walking time						
Walking time (h/day), median (IQR)	1 (1-2)	1 (1-1)	<0.01	1 (1-1)	1 (0-1)	<0.01
<0.5 h/day, n (%)	47 (16.4%)	71 (24.7%)	<0.05	36 (22.0%)	60 (36.6%)	<0.01
0.5-2 h/day, n (%)	164 (57.1%)	158 (55.1%)		101 (61.6%)	87 (53.0%)	
≥2 h/day, n (%)	76 (26.5%)	58 (20.2%)		27 (16.5%)	17 (10.4%)	
Exercise time						
Exercise time (min/week), median (IQR)	30 (0-120)	30 (0-120)	<0.05	0 (0-90)	0 (0-97.5)	0.163
<30 min/week, n (%)	131 (45.6%)	143 (49.8%)	0.059	93 (56.7%)	106 (64.6%)	<0.05
≥30 min/week, n (%)	156 (54.4%)	144 (50.2%)		71 (43.3%)	58 (35.4%)	
Number of meals per day, median (IQR)	3 (2-3)	3 (2-3)	0.877	3 (3-3)	3 (3-3)	0.11
Adequate rest, n (%)	62 (21.6%)	52 (18.1%)	0.055	44 (26.8%)	33 (20.1%)	<0.05
Non-adherence, n (%)	73 (25.4%)	70 (24.4%)	0.371	29 (17.7%)	28 (17.1%)	1
Stress						
Stress due to childcare burden, n (%)	22 (7.7%)	20 (7.0%)	0.480	19 (11.6%)	20 (12.2%)	1
Stress due to COVID-19, n (%)	58 (20.2%)	63 (22.0%)	0.182	47 (28.7%)	58 (35.4%)	<0.05
Stress due to family budget, n (%)	54 (18.8%)	56 (19.5%)	0.773	19 (11.6%)	23 (14.0%)	0.289
Stress due to inability to exercise, n (%)	75 (26.1%)	90 (31.4%)	<0.01	53 (32.3%)	59 (36.0%)	0.211
Stress due to staying indoors, n (%)	50 (17.4%)	66 (23.0%)	<0.01	41 (25.0%)	55 (33.5%)	<0.01
Stress due to inflammatory bowel disease, n (%)	62 (21.6%)	64 (22.3%)	0.803	30 (18.3%)	27 (16.5%)	0.371
Stress due to worsening of diet and nutritional status, n (%)	25 (8.7%)	24 (8.4%)	1	15 (9.1%)	15 (9.1%)	1

COVID-19: Coronavirus disease 2019, IQR: interquartile range

19 pandemic on lifestyle factors and psychological stress in the general population (32, 33) and in patients with IBD (21, 34); however, only a few studies have evaluated lifestyle changes and psychological stress levels with a particular focus on age and sex differences in these patients.

Generally, isolation periods, such as the COVID-19 lockdown, are associated with stress and depression that in turn lead to unhealthy diets and reduced physical activity (35). The patients in our study reported a longer sleep duration during COVID-19 lockdown, a finding consistent with previous reports (32, 33); this was possibly to compensate for their sleep deficit.

No significant differences were observed in the changes in psychological stress levels due to the inability to exercise during the lockdown in women; the COVID-19 lockdown therefore does not seem to have affected the exercise duration in women, probably because relatively few women ex-

ercised in the pre-lockdown period as well. Other lifestyle factors evaluated in this study, both in the overall study sample and in men and women, changed in a similar direction. The same can be said for comparisons between UC and CD patients. However, lifestyle factors in elderly patients did not change markedly compared with that noted in non-elderly patients during the lockdown.

Psychological stress

Previous studies have reported that decreased physical activity due to COVID-19 lockdown is associated with a greater risk of depression, anxiety, and stress (36). People experience increased emotional disturbance, anxiety, and general stress levels as well as low mood during lockdowns (3-6). However, the proportion of patients who were stressed due to family budget, an inability to exercise, and having to stay indoors increased during the lockdown in

Table 4. **Comparison of the Lifestyle Factors and Psychological Stress in Elderly and Non-elderly Patients between Pre-lockdown and Lockdown Periods.**

	Non-elderly patients (n=382)			Elderly patients (n=69)		
	Pre-lockdown	During lockdown	p value	Pre-lockdown	During lockdown	p value
Lifestyle						
Sleeping time						
Median (IQR) (h/day)	6 (6-7)	6 (6-7)	<0.01	6 (6-7)	6 (6-7)	<0.05
<7 h/day, n (%)	223 (58.4%)	201 (52.6%)	<0.01	35 (50.7%)	37 (53.6%)	0.48
≥7 h/day, n (%)	159 (41.6%)	181 (47.4%)		34 (49.3%)	32 (46.4%)	
Working time						
Working time (h/week), median (IQR)	40 (10-45)	25 (0-40)	<0.01	0 (0-4)	0 (0-0)	0.058
<20 h/week	113 (29.6%)	169 (44.2%)	<0.01	57 (82.6%)	58 (84.1%)	1
20-40 h/week	65 (17.0%)	59 (15.4%)		8 (11.6%)	7 (10.1%)	
≥40 h/week	204 (53.4%)	154 (40.3%)		4 (5.8%)	4 (5.8%)	
Walking time						
Walking time (h/day), median (IQR)	1 (1-1)	1 (0-1)	<0.01	1 (1-1)	1 (1-1)	0.582
<0.5 h/day, n (%)	72 (18.8%)	116 (30.4%)	<0.01	11 (15.9%)	15 (21.7%)	0.595
0.5-2 h/day, n (%)	219 (57.3%)	205 (53.7%)		46 (66.7%)	40 (58.0%)	
≥2 h/day, n (%)	91 (23.8%)	61 (16.0%)		12 (17.4%)	14 (20.3%)	
Exercise time						
Exercise time (min/week), median (IQR)	15 (0-120)	0 (0-77.5)	<0.01	90 (0-240)	60 (0-210)	0.889
<30 min/week, n (%)	200 (52.4%)	222 (58.1%)	<0.01	24 (34.8%)	27 (39.1%)	0.45
≥30 min/week, n (%)	182 (47.6%)	160 (41.9%)		45 (65.2%)	42 (60.9%)	
Number of meals per day, median (IQR)	3 (2-3)	3 (2-3)	0.482	3 (3-3)	3 (3-3)	NA
Adequate rest, n (%)	95 (24.9%)	76 (19.9%)	<0.01	106 (23.5%)	85 (18.8%)	0.617
Non-adherence, n (%)	92 (24.1%)	88 (23.0%)	0.289	10 (14.5%)	10 (14.5%)	1
Stress						
Stress due to childcare burden, n (%)	41 (10.7%)	40 (10.5%)	1	0 (0%)	0 (0%)	NA
Stress due to COVID-19, n (%)	92 (24.1%)	107 (28.0%)	<0.01	13 (18.8%)	14 (20.3%)	1
Stress due to family budget, n (%)	70 (18.3%)	74 (19.4%)	0.48	3 (4.3%)	5 (7.2%)	0.480
Stress due to inability to exercise, n (%)	113 (29.6%)	131 (34.3%)	<0.01	15 (21.7%)	18 (26.1%)	0.371
Stress due to staying indoors, n (%)	81 (21.2%)	108 (28.3%)	<0.01	10 (14.5%)	13 (18.8%)	0.371
Stress due to inflammatory bowel disease, n (%)	83 (21.7%)	82 (21.5%)	1	9 (13.0%)	9 (13.0%)	1
Stress due to worsening of diet and nutritional status, n (%)	34 (8.9%)	34 (8.9%)	1	6 (8.7%)	5 (7.2%)	1

COVID-19: coronavirus disease 2019, IQR: interquartile range, NA: not available

non-elderly patients, whereas no significant differences in these factors were detected in elderly patients. Regarding the differences between the two conditions, those with UC felt more stressed due to an inability to exercise and having to stay indoors during the lockdown; in contrast, patients with CD felt more stressed only because they had to stay indoors among factors examined in the survey. In patients with UC, perceived stress is reported to be associated with an increased risk of exacerbation (30). This highlights the need to provide timely psychological support to vulnerable patient populations.

Drug adherence

Drug adherence did not change markedly during the lockdown. These findings are similar to those of a recent report in patients with IBD, among whom approximately 4% discontinued medication (37). None of the patients reported changing or discontinuing IBD medication based on their own judgment. Even in cases with good drug adherence, it is important to instruct patients to continue to adhere to their prescribed treatments, as treatment cessation may negatively impact disease control and result in potential complications.

Limitations

Several limitations associated with the present study warrant mention. First, we used self-administered questionnaires, which can lead to misreporting of data and recall bias. This also prevented us from evaluating objective factors. Second, no cases of COVID-19 were registered in our study sample. It is important to analyze patients with COVID-19 in order to evaluate the impact of the COVID-19 lockdown on patients with IBD. Furthermore, we collected and analyzed data only on sleep and exercise durations; we

Table 5. Comparison of the Lifestyle Factors and Psychological Stress in Patients with Ulcerative Colitis and Patients with Crohn's Disease between Pre-lockdown and Lockdown Periods.

	Ulcerative colitis (n=241)			Crohn's disease (n=210)		
	Pre-lockdown	During-lockdown	p value	Pre-lockdown	During-lockdown	p value
Lifestyle						
Sleeping time						
Median (IQR) (h/day)	6 (6-7)	6 (6-7)	<0.05	6 (6-7)	6 (6-7)	<0.01
<7 h/day, n (%)	140 (58.1%)	132 (54.8%)	0.080	118 (56.2%)	106 (50.5%)	<0.01
≥7 h/day, n (%)	101 (41.9%)	109 (45.2%)		92 (43.8%)	104 (49.5%)	
Working time						
Working time (h/week), median (IQR)	28 (0-40)	12 (0-40)	<0.01	40 (0-45)	27.5 (0-40)	<0.01
<20 h/week	100 (41.5%)	135 (56.0%)	<0.01	70 (33.3%)	92 (43.8%)	<0.01
20-40 h/week	44 (18.3%)	30 (12.4%)		29 (13.8%)	36 (17.1%)	
≥40 h/week	97 (40.2%)	76 (31.5%)		111 (52.9%)	82 (39.0%)	
Walking time						
Walking time (h/day), median (IQR)	1 (1-1)	1 (0-1)	<0.01	1 (1-1)	1 (0-1)	<0.01
<0.5 h/day, n (%)	39 (16.2%)	74 (30.7%)	<0.01	44 (21.0%)	57 (27.1%)	<0.01
0.5-2 h/day, n (%)	150 (62.2%)	133 (55.2%)		115 (54.8%)	112 (53.3%)	
≥2 h/day, n (%)	52 (21.6%)	34 (14.1%)		51 (24.3%)	41 (19.5%)	
Exercise time						
Exercise time (min/week), median (IQR)	30 (0-120)	0 (0-120)	<0.05	15 (0-120)	12.5 (0-97.5)	0.210
<30 min/week, n (%)	116 (48.1%)	137 (56.8%)	<0.01	108 (51.4%)	112 (53.3%)	0.556
≥30 min/week, n (%)	125 (51.9%)	104 (43.2%)		102 (48.6%)	98 (46.7%)	
Number of meals per day, median (IQR)	3 (3-3)	3 (3-3)	0.464	3 (2-3)	3 (2-3)	0.835
Adequate rest, n (%)	59 (24.5%)	52 (21.6%)	0.265	47 (22.4%)	33 (15.7%)	<0.01
Non-adherence, n (%)	46 (19.1%)	42 (17.4%)	0.075	56 (26.7%)	56 (26.7%)	0.356
Stress						
Stress due to childcare burden, n (%)	22 (9.1%)	22 (9.1%)	1.000	19 (9.0%)	18 (8.6%)	1
Stress due to COVID-19, n (%)	52 (21.6%)	63 (26.1%)	<0.05	53 (25.2%)	58 (27.6%)	0.182
Stress due to family budget, n (%)	30 (12.4%)	37 (15.4%)	0.096	43 (20.5%)	42 (20.0%)	1
Stress due to inability to exercise, n (%)	65 (27.0%)	81 (33.6%)	<0.01	63 (30.0%)	68 (32.4%)	0.302
Stress due to staying indoors, n (%)	48 (19.9%)	67 (27.8%)	<0.01	43 (20.5%)	54 (25.7%)	<0.05
Stress due to inflammatory bowel disease, n (%)	38 (15.8%)	41 (17.0%)	0.546	54 (25.7%)	50 (23.8%)	0.343
Stress due to worsening of diet and nutritional status, n (%)	10 (4.1%)	11 (4.6%)	1	30 (14.3%)	28 (13.3%)	0.683

COVID-19: coronavirus disease 2019, IQR: interquartile range

did not evaluate the quality of sleep and exercise, which should be considered when assessing risk factors for IBD flares. Moreover, as this study included only patients with IBD, we were unable to elucidate whether these results were specific to those with IBD or applied to those without IBD as well. Another limitation was that this was a single-center study in a relatively small cohort. We therefore cannot deny that a significant difference may have been missed due to the small number of patients included, especially in the non-elderly group. Larger prospective studies, including both patients with and without IBD, are needed to confirm the impact of the COVID-19 lockdown on patients with IBD.

In conclusion, to our knowledge, this is the first study to provide data on changes in lifestyle factors and psychological stress in Japanese patients with IBD during COVID-19 lockdown, with a particular focus on age and sex differences. Psychological stress levels and lifestyle factors, some

of which are known to be associated with IBD exacerbations, changed during the lockdown. The present findings may be helpful in suggesting favorable lifestyle changes for patients with IBD to avoid deterioration during COVID-19 lockdown.

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