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Research Paper

A longitudinal comparison of college student mental health under the COVID-19 self-restraint policy in Japan

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ABSTRACT

Background: The coronavirus-19 (COVID-19) pandemic has resulted in substantial mental health problems. In addition to the fear of infection, prevention policies that result in isolation such as lockdowns or, in Japan, "self-restraint," are associated with psychological symptoms. University students are vulnerable to emotional disorders because of the psychological challenges associated with the transition to adulthood. Therefore, we investigated changes in the mental health of university students before and during the COVID-19 pandemic.
Methods: We used data from depression screening conducted by the University of Tsukuba, Japan, during student health examinations. Students completed the Patient Health Questionnaire-9 (PHQ-9) and an open-ended question on stress self-coping.
Results: In 2020, 9.6% of students were depressed, approximately twice as many as in previous years. The paired samples Wilcoxon test showed that PHQ-9 scores were significantly higher in 2020 than in 2019; the largest effect size was for sleep difficulties. Analysis of the open-ended responses for stress coping strategies showed that physical activity and online communication were most frequently used.
Limitations: The 2020 survey was web-based, whereas the surveys in previous years were completed in person. Only approximately one-sixth of participants answered the open-ended question.
Conclusions: The percentage of students with mental health problems has doubled, and more attention to student mental health is needed. However, many students seem to be using appropriate coping measures. Education about best practices and raising awareness about establishing and maintaining sleep–wake rhythms may be useful.

1. Introduction

Coronavirus 19 (COVID-19) was first reported in China in December 2019, and the World Health Organization (WHO) declared COVID-19 to be a pandemic in May 2020. Since then, COVID-19 has spread rapidly around the world, causing mental health problems for many people. In addition to the fear of infection, psychological stressors caused by quarantine, social distancing, self-restraint, and other containment policies have lead to symptoms such as anxiety, depression, and stress. (Moreno et al., 2020) According to one systematic review, studies on psychological outcomes in the general population have found

substantial anxiety (6.3% to 50.9%), depression (14.6% to 48.3%), posttraumatic stress disorder (7% to 53.8%), psychological distress (34.4% to 38.4%), and stress (8.1% to 81.9%) in China, Spain, Italy, Iran, the United States, Turkey, Nepal, and Denmark. (Xiong et al., 2020) Fear and anxiety about infection are normal responses to life-threatening diseases, and these emotions are important in motivating compliance with behaviors that help to control the spread of infection, such as spatial distancing and hand washing. (Harper et al., 2020; Pakpour and Griffiths, 2020) However, these feelings can also increase levels of loneliness, harmful alcohol and drug use, self-harm, and suicidal behavior. (WHO/Europe, 2020)

College students are considered a vulnerable population for mental health problems because of the psychological challenges associated with the transition to adulthood and susceptibility to economic and material difficulties. (Auerbach et al., 2018; Husky et al., 2020; JN Rubley, 2017) The transition from high school to college is one of the biggest life changes and is often associated with adjustment problems. (Fisher and Hood, 1987) Therefore, COVID-19 may have a particularly large effect on the mental health of college students.

In fact, surveys in various countries have reported worsening of mental health among college students owing to COVID-19. In China, which experienced the earliest COVID-19 epidemic, 21.3% to 38.1% of students have reported anxiety symptoms. (Cao et al., 2020; Li et al., 2020; Lin et al., 2020) An online cross-sectional study in Malaysia found that 29.8% of 983 students had anxiety symptoms. (Sundarasen et al., 2020) A study of students in the United States reported that 48.1% of students were depressed, 38.5% had moderate to severe anxiety, and 18.0% expressed suicidal thoughts. (Wang et al., 2020) A Spanish study found moderate to severe anxiety, depression, and stress in 21.3%, 34.1%, and 28.1% of students, respectively. (Odriozola-González et al., 2020) A study of students in Greece found that 12.4% had depression. (Patsali et al., 2020)

A state of emergency was declared on April 7, 2020, in Japan. The Japanese school year begins in April in Japan, so many universities postponed their courses and university campuses were closed to students. The University of Tsukuba delayed opening by 2 weeks and from April 28, face-to-face lectures were replaced with on-demand lectures. This forced students to refrain from going out and stay in their rooms, making it easier for them to self-isolate. It is likely that this situation has greatly affected the mental health of Japanese university students, but there are few large-scale university student mental health surveys related to COVID-19. Nomura (2020) In addition, most previous studies have used anonymous Internet surveys; there are few longitudinal surveys of the total student population of a single university that have identified individuals, and such surveys are relatively small. (Elmer et al., 2020; Ge et al., 2020; Jeremy F Huckins et al., 2020)

In this study, we investigated COVID-19-related changes in the mental health of university students. We used the results of depression screening and other surveys conducted by the University of Tsukuba Health Care Center as part of a medical checkup for students.

2. Methods

2.1. Procedure

To enable early detection and prevention of mental health problems in students, the University of Tsukuba Health Management Center has used the Patient Health Questionnaire-9 (PHQ-9) (Kroenke et al., 2001) in general student physical examinations since 2016. The PHQ-9 is an international, standardized screening tool for depression. The university also performs a mental health checkup, in which criteria are set, primary screening is conducted, subjects are called up, and a diagnostic interview is conducted by a psychiatrist as a secondary screening. In 2020, the medical checkup, which is usually conducted in April, was postponed because of COVID-19 countermeasures. Therefore, a web-based questionnaire survey was conducted in June using the cloud-based learning management system for regular lectures. A question about difficulties experienced owing to COVID-19 was added to the usual PHQ-9 survey. Students who screened positive on the survey and were suspected of being depressed were called for an interview. The survey results were then analyzed.

2.2. Items and scales

Respondents were asked to complete a survey questionnaire comprising questions on demographic characteristics, the PHQ-9, and the following open-ended question: "Please tell us what you did to cope

with the situation of required self-restraint and anything else you would like to share with us."

PHQ-9 items are rated on a four-point Likert scale from 0 (not at all) to 3 (almost every day). The total score ranges from 0 to 27, with a recommended cutoff score of 10. (Kroenke et al., 2001) The Japanese version of the PHQ-9 has also been standardized. (Muramatsu et al., 2007)

2.3. Subjects and methods

Subjects were students at the University of Tsukuba enrolled in each academic year from 2016 to 2019 and who were administered the PHQ-9 during the health examination, and students who were enrolled in 2020 and were administered the web survey (including the PHQ-9). The results of the PHQ-9 questionnaire and web survey were tabulated, and the following analyses were conducted.

3. Study 1: Comparison of PHQ-9 total scores of populations by year

Total PHQ-9 scores for each year between 2016 and 2020 were analyzed using a repeated measures cross-sectional design. Subjects were students enrolled at the University of Tsukuba from 2016 to 2019 who underwent annual health examinations, and those who completed the PHQ-9 in the web survey in 2020. Regarding demographic data, sex ratio and age were compared using the χ^2 test and analysis of variance (ANOVA). PHQ-9 scores for each year were also compared using ANOVA.

4. Study 2: Comparison of PHQ-9 scores between 2019 and 2020

We analyzed responses to each PHQ-9 item retrospectively for students who had completed the PHQ-9 in the web survey in 2020 and in the health examination in 2019. The means of item-specific scores were compared using the paired *t*-test, and effect sizes were calculated for each item using Cohen's d and Pearson's correlation coefficient r.

5. Study 3: Descriptive analysis of coping methods for the situation of self-restraint

We extracted nouns using morphological analysis from responses to the open-ended question "Please tell us what you did to cope with the situation of required self-restraint and anything else you would like to share with us." Ranks were assigned to each noun based on its frequency. We visualized the results using a "word cloud," which used larger font sizes for higher ranked items. We used Python 6.3 for analysis and the Japanese morphological analysis engine MeCab (Kudo et al., 2004).

6. Ethics

Opt-out research consent was used. The Health Administration Center website explained to participants of the health checkup the study content and the right to refuse the provision of data. Anonymized population data were used for analysis, and care was taken to protect personal information. The study was conducted with the approval of the University of Tsukuba Medical Ethics Committee (Approval No. 1567).

7. Results

7.1. Study 1: comparison of PHQ-9 total scores of populations by year

Table 1 shows the demographics of the populations by year and the PHQ-9 total scores. There were 12,853, 12,796, 12,629, 12,265, and 12,355 subjects in the five surveys from 2016 to 2020, respectively, a cumulative total of 62,898 subjects. The proportion of women ranged from 39.7% to 41.1% and the difference across years was not significant

Table 1

Population demographics, PHQ-9 total scores, and PHQ-9 mean scores by year. PHQ, Patient Health Questionnaire-9; SD, standard deviation.

year		2016 (n = 12,853)		2017 (n = 12,796)		2018 (n = 12,629)		2019 (n = 12,265)		2020 (n = 12,355)		total (n = 62,898)	
age													
	mean±S.D.	22.4 ± 3.9		22.4 ± 3.8		22.4 ± 3.8		22.4 ± 4		23.4 ± 5.9[a]		22.6 ± 4.3	
sex	n, (%)												
	female	5148	(40.1%)	5076	(39.7%)	5101	(40.4%)	4871	(39.7%)	5081	(41.1%)	25,277	(40.2%)
	male	7705	(59.9%)	7720	(60.3%)	7528	(59.6%)	7394	(60.3%)	7274	(58.9%)	37,621	(59.8%)
Student status	n, (%)												
	undergraduate	8502	(66.1%)	8489	(66.3%)[a]	8317	(65.9%)	8072	(65.8%)	7823	(63.3%)[b]	41,203	(65.5%)
	graduate	4014	(31.2%)[a]	4015	(31.4%)[a]	4006	(31.7%)	3927	(32.0%)	4336	(35.1%)[b]	20,298	(32.3%)
	other	337	(2.6%)[a]	292	(2.3%)	306	(2.4%)	266	(2.2%)	196	(1.6%)[b]	1397	(2.2%)
PHQ-9 total													
	mean±S.D.	2.7	±3.4	2.8	±3.4	2.8	±3.4	2.9	±3.5	4.0	±4.2[c]		
PHQ-9 total≥10													
	n, (%)	595	(4.6%)[a]	623	(4.9%)[a]	627	(5.0%)[a]	649	(5.3%)[a]	1190	(9.6%)[a]		

[a] one-way ANOVA, $p<0.001$.
[b] χ^2test $p<0.05$ and adjusted residual >1.96.
[c] Kruskal–Wallis test, $p<0.001$.

according to the χ^2 test. ($\chi^2 = 7.4$, df $= 4$, $p = 0.126$).

When we divided students into undergraduates, graduate students, and other students and compared the ratios for each year, the percentage of graduate students in 2020 was 35.1%, which was significantly higher than in other years ($\chi^2 = 85.4$, df $= 8$, $p < 0.001$).

From 2016 to 2020, the mean age ranged from 22.4 to 23.4 years, and there was a significant difference across years (F(4, 62,893) $= 120.3$, $p < 0.001$). In 2020, the mean age was significantly higher than in the other years.

The mean PHQ-9 total score for each year ranged from 2.74 to 4.01, and this difference was significant (F(4, 62,893) $= 289.2$, $p < 0.001$). Multiple comparisons were performed using the Tukey honest significant difference test, which showed that scores were significantly higher in 2020 than in the other years ($p < 0.001$).

The percentage of subjects with a PHQ-9 total score of 10 or higher in each year ranged from 4.6% to 9.6% from 2016 to 2020, and depression was approximately twice as frequent in 2020 as in other years ($\chi^2 = 402.4$, df $= 4$, $p = p<0.001$).

7.2. Study 2: Comparison of PHQ-9 scores between 2019 and 2020

A total of 6847 respondents completed the questionnaire in both 2019 and 2020, of which 358 (5.2%) and 669 (9.8%) had total PHQ-9 scores of 10 or higher, respectively.

As shown in Table 2, PHQ-9 total scores and PHQ-9 item scores were compared for students who responded to the PHQ-9 in both 2019 and 2020. Total PHQ-9 scores and scores on each PHQ-9 item except item 8 (psychomotor agitation/retardation) were higher in 2020 than in 2019. Item 3 (sleep difficulties) showed the largest effect size: Cohen's $d = 0.34$ and Pearson's correlation coefficient $r = 0.32$.

7.3. Study 3: Descriptive analysis of coping methods for the situation of self-restraint

A total of 2386 students responded to the question "Please tell us what you did to cope with the situation of required self-restraint and anything else you would like to share with us." A total of 12,345 nouns were extracted from the 2151 responses analyzed using Japanese morphological analysis. The extracted nouns were tabulated in order of frequency; the first 100 are shown in Table 3. The students appeared to actively devise ways to spend their time during self-restraint. Among them, physical activities such as exercise, muscle training, and walking were frequently mentioned. Calling and talking to friends and family online was also considered a good way to spend time. Fig. 1 shows the analysis output in the form of a word cloud (the Japanese terms have been translated into English). The color and location of each word are random, but the font size corresponds to the frequency of the words. The words friends, time, online, self, and exercise frequently occurred, indicating that these problems and coping measures were considered central by the students.

8. Discussion

To the best of our knowledge, this is the first study to analyze large-scale, longitudinal data for the effects of Covid-19 on the mental health of almost all college students at one university.

The results of Study 1 showed that PHQ-9 scores were significantly higher in 2020 compared with all other years, and the number of students considered depressed was twice as high as in previous years (almost 10%). There were also differences in demographic data in 2020; students in that year were older and there was a higher proportion of graduate students. In Study 2, we compared the same variables for 2019 and 2020. We found that PHQ-9 scores were higher in 2020, suggesting that depression in college students increased mainly because of the

Table 2

Comparison of responses to PHQ-9 items in 2019 and 2020 and corresponding paired samples Wilcoxon test. PHQ, Patient Health Questionnaire-9.

PHQ-9 Item	2019	2020	Z	df	p	effect-size
1. Anhedonia	0.27±0.52	0.46±0.68	−21.6	6846	<0.01	−0.26
2. Depressed mood	0.39±0.61	0.56±0.72	−18.4	6846	<0.01	−0.22
3. Sleep difficulties	0.56±0.77	0.89±0.92	−26.5	6846	<0.01	−0.32
4. Feeling tired	0.65±0.74	0.83±0.84	−16.3	6846	<0.01	−0.20
5. Appetite changes	0.38±0.65	0.44±0.7	−5.5	6846	<0.01	−0.07
6. Feeling of worthlessness	0.24±0.56	0.36±0.68	−13.5	6846	<0.01	−0.16
7. Concentration problems	0.2 ± 0.51	0.3 ± 0.64	−12.3	6846	<0.01	−0.15
8. Psychomotor agitation/retardation	0.13±0.41	0.12±0.4	−2.5	6846	0.011	0.03
9. Suicidal thought	0.06±0.29	0.08±0.34	−4.5	6846	<0.01	−0.05
total	2.89±3.44	4.05±4.17	−25.4	6846	<0.01	−0.31

Table 3
The top 100 nouns extracted from responses to the open-ended question about coping methods. Nouns are presented in order of frequency.

| frequency	english	frequency	english	frequency	english
243	time	52	movies	26	stretch
223	online	52	video	26	refresh
218	motion	50	room	25	A lot
195	friend	49	corona	25	infection
186	friend	48	spirit	24	together
149	every day	46	training	24	Part-Time Job
145	walk	45	Moderate	23	clean up
141	phone	44	Communication		Before high school
140	Muscle training		University	23	State
139	hobby	43	Book	23	computer
138	House	42	TV set	22	Shortage
138	myself	42	the study	22	Consciousness
135	Self-discipline	42	zoom	22	Net
130	family	41	musics		anxiety
124	Telephone call		The feeling	22	Talk
118	life	38	opportunity	22	mask
112	study	38	self catering	22	challenging
112	game	38	health	21	sleep
109	Lesson	37	Habit	21	cancelation
73	cuisine	37	Regularly	20	heart
73	Task	36	The video	20	Zoom
68	running	34	Meal	19	days
67	stress	34	SNS	19	YouTube
66	conversation	34	Home	19	yoga
64	Outside	33	Who	19	remote
64	now	32	Morning	18	Living alone
63	Go out	31	Concentration		frequent
61	environment	31	communication	18	shopping
61	Feeling	31	body	18	Positive
58	Meeting	30	Feeling	18	others
57	home	30	information		work
57	Change of pace		Purchase	18	Night
55	reading	28	share	18	radio
55	usually	27	interaction		
55	Like	27	rhythm		
55	Care	27	Activity		
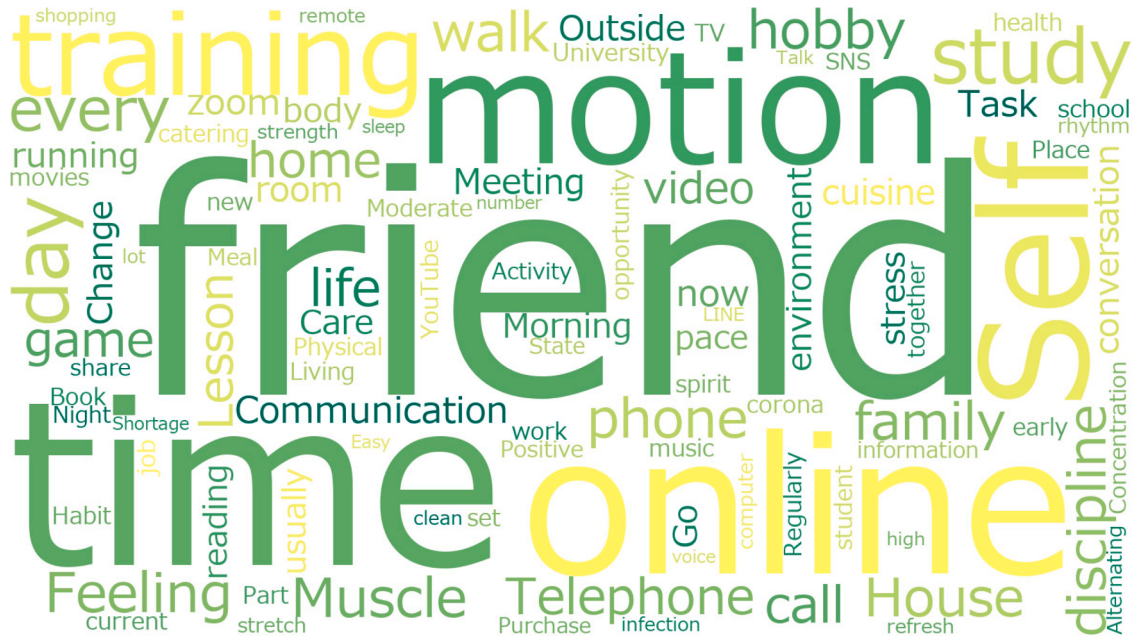
Fig. 1. The output of a word cloud showing nouns extracted from responses to the open-ended question about coping methods (words have been translated from the Japanese). The color and location of each word are random, but the font size corresponds to the frequency of the words.

effect of COVID-19, not because of differences in demographic characteristics.

In the longitudinal comparison of the PHQ-9 item scores, scores were worse in 2020 than in 2019 for all items except item 8 (psychomotor agitation/retardation), and the largest effect size was for the sleep disorder item. Because self-restraint reduces the amount of time spent in the sun, and on-demand lectures do not require students to get up early, circadian rhythms are more likely to be disrupted in university students

under self-restraint. Populations that sleep less than 6 h a night are more likely to experience posttraumatic stress disorder and depression, and there is evidence that sleep duration mediates the effect of Covid-19 exposure on mental health. (Tang et al., 2020) Ge et al. used a machine-learning algorithm to show that sleep symptoms predicted anxiety in a web survey during the Covid-19 pandemic. (Ge et al., 2020) Therefore the provision of health guidance to students should focus on their sleep rhythms.

We found no significant difference between years in responses to items on anxious agitation and psychomotor control (item 8). Mental health problems associated with COVID-19 include fear and anxiety about contracting COVID-19 and stress reactions associated with isolation as a COVID-19 countermeasure. (Cao et al., 2020) The frequency of these problems varies according to the level of COVID-19 prevalence in a particular area and other environmental factors, such as whether there are infected people nearby. (Brooks et al., 2020) In this study, stress associated with isolation may have been high because the severity of COVID-19 infection was relatively low in Japan, and the fear and anxiety related to contracting the disease were low.

The responses to the open-ended question in Study 3 suggest that paying attention to daily rhythms, using time effectively, and connecting with friends online are good for students' mental health. Exercise is important in improving sleep disorders, so it is unsurprising that students rated exercise highly as a coping method. A study in the United States showed that the time spent in sedentary behaviors has increased during the COVID-19 pandemic (Jeremy F. Huckins et al., 2020); therefore, students need to be aware of the need for exercise. The use of online games as a stress coping method correlates with worse depression so should be treated with caution. (Cheng et al., 2020) There is evidence that augmented reality games that involve communication and physical movement are beneficial to mental health (Ellis et al., 2020). However, the use of such games must be appropriate to the situation.

The limitations of this study are as follows. The survey conducted in 2020 was a web-based survey. This was different to the surveys in other years, which students were asked to complete in person during medical checkups. There were also differences in the participant demographics in 2020 compared with other years, including the fact that students who responded to the survey in 2020 were older than those who responded in other years, and there was a higher percentage of graduate students in 2020. The average age of graduate students is higher than that of undergraduates. Therefore, this observed age difference may reflect the fact that graduate students, who normally do not undergo medical checkups owing to their involvement in research fieldwork and other commitments, underwent medical checkups because of the self-restraint caused by COVID-19. Therefore, the results of the 2020 survey must be interpreted with caution owing to possible bias in the target population and survey method. Furthermore, only approximately one-sixth of the sample responded to the open-ended question about coping methods in 2020, so the representativeness of students' opinions is unclear.

Despite these limitations, the findings showed that the worsening of depression among college students owing to self-restraint as a COVID-19 countermeasure is a major problem. Although students are vulnerable to mental health problems, only 5% of students who experience anxiety and depression have used mental health counseling. (Son et al., 2020) Under self-restraint conditions, many students are hesitant to return to their hometown because they will have to live with older people who are at high risk for COVID-19. Organizations such as universities and local governments need to pay attention to the mental health of students, increase appropriate support and online access to this support, and raise awareness of the mental health maintenance strategies implemented by many of the students in this study to prevent mental health problems.

9. Conclusion

The percentage of students showing mental health problems in 2020 in this sample doubled, so there is a need to pay attention to student mental health issues. However, it appears that many students are taking appropriate steps to cope with stress. The presentation of best practices and raising awareness of the need to establish and maintain healthy sleep–wake rhythms may be effective. Students are a vulnerable group in terms of support and financial resources, but are also likely to be very adaptable. We should take advantage of their strengths and resilience in generating appropriate support strategies.

Declaration of Competing Interest

The authors have no conflict of interest to declare.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jadr.2022.100314.

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