


Original Research

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Psychological Distress During the Coronavirus Disease 2019 Pandemic and Associated Factors Among Undergraduate Students in Japan

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Abstract

Objective: This cross-sectional study aimed to examine factors potentially associated with psychological distress among undergraduate students during the coronavirus disease 2019 pandemic in Japan.

Methods: We analyzed data of 958 undergraduates (median age 20 y; 56.8% women) from a Web-based, self-administered questionnaire survey conducted from August to September 2020. Prevalence ratios (PRs) for psychological distress defined as 5 points or over of the Kessler Psychological Distress Scale (K6) were calculated by Poisson regression models.

Results: The proportion of psychological distress was 40.0%. In the mutually-adjusted model, the following were significantly associated with psychological distress: decreases in household income to 50–99% of the prepandemic amount compared with no change (PR = 1.48), newly experiencing unpaid wages compared with no experience (PR = 1.44), insufficient money to buy necessities compared with no shortage (PR = 1.45), receiving a student loan or scholarship compared with none (PR = 1.27), and communication 1 to 3 times a month compared with at least once a week (PR = 1.22). In contrast, school closure during the pandemic compared with no closure was inversely associated with psychological distress (PR = 0.78).

Conclusions: Among undergraduate students in Japan, economic difficulties significantly predicted psychological distress.

The first case of a novel coronavirus was identified in late December 2019, and the subsequent coronavirus disease 2019 pandemic has altered people's lives. National governments imposed interventions including lock-down, social distancing, and school closures.¹ Such measures led to frustration and anxiety.^{2–5} In addition, the world's gross domestic product decreased by at least 6% in 2020.⁶ Economic difficulties potentially led to disproportionate mental health problems, particularly for individuals with lower socioeconomic status.⁷

Students in higher education faced academic difficulties. Closure of academic institutions forced students to shift from face-to-face to online lectures, but some students lacked the infrastructure or resources to make this change.⁸ They also lost part-time jobs due to the economic downturn.⁹ Financial insecurity was an important risk factor for worse mental health.^{9–12} In particular, 1st-year and 4th-year students were at risk because 1st-year ones could be more isolated due to lesser opportunities of visiting their campuses, and 4th-year ones could be concerned about uncertainty about their postgraduation careers and the economy.^{9,11,13}

Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) reported that the proportion of students who dropped out or took a leave of absence between April and October 2020 did not largely differ from the same period in 2019.¹⁴ Also, a previous study reported that the prevalence of 2020 first-year students who had psychological distress was lower than in 2019.¹⁵ On the other hand, the prevalence of academic distress in 2020 first-year students was higher than that in 2019. The reason might be that they had to prepare and adapt to an unexpected educational environment, such as online lectures. A report showed that 35.4% of the undergraduates expected a decline in their family's income and 50.4% of those expected a decline in their total income from part-time jobs due to the pandemic.¹⁶ Students with economic insecurity had more anxiety and worry than those without insecurity.¹⁷ It was, therefore, important to explore the living and socio-economic environment of undergraduates in relation to psychological distress for the prevention of more serious mental disorder or possible adverse consequences for academic achievement. To our knowledge, only one study has reported the impacts of lifestyle changes due to the coronavirus disease 2019 pandemic on psychological status among Japanese medical students.¹⁸ In Japan, high school graduates enroll in university and take 6 y to pass through undergraduate medical education. Medical students who had concerns

about a shifting to online education had an increased risk for depression. Requesting food aid was also a risk factor. However, to our knowledge, no study has examined this topic among the students in higher education in a wide range of Japanese population. This study aimed to examine factors potentially associated with psychological distress among undergraduate students in Japan during the coronavirus disease 2019 pandemic.

Methods

Ethical Approval

The study protocol was reviewed and approved by the Research Ethics Committee of the Osaka International Cancer Institute (approved on June 19, 2020; approval number 20084). All participants provided Web-based informed consent before responding to the online questionnaire. They could choose to respond and quit answering at any point. A credit point known as “Epoints,” which could be used for Internet shopping and cash conversion, was provided to the participants as an incentive. The exact value of “Epoints” was not disclosed at the Internet research agency’s request.

Data Sources and Participants

This cross-sectional study used data from the Japan “COVID-19 and Society” Internet Survey (JACSIS). This Web-based and self-administered questionnaire survey was conducted by a large Internet research agency in Japan. The approximately 2.2 million registered panelists covered not only students in higher education but also individuals with a wide range of social categories in Japan. The Internet research agency recruited participants from the registrants by means of accessing a designated website to answer the self-administered questionnaire. The recruitment based on random sampling stratified by sex, age, and prefecture continued until collecting 28,000 participants aged 15–79 y between August 25 and September 30, 2020 (37 d), approximately 3 mo after the first state of emergency in Japan ended.¹⁹ Data collection ended when the target sample was reached. The response rate of 12.5% (28,000/224,389) was low due to the nature of Internet surveys. We excluded 2518 participants with invalid or inconsistent responses using the algorithm we developed earlier.^{20,21} Current analyses were restricted to university and college students not including postgraduates ($n = 1030$) based on a self-administered question. Medical students were included as undergraduates. We excluded 47 students who reported any kind of mental disorder because they likely had psychological stress since before the pandemic. Additionally, because grade skipping is rare for under 17 y old, 25 participants aged under 17 y or over 25 y at April 1, 2020 and age unknown were also excluded, leaving 958 students reported attending university or college.

Dependent Variable: Psychological Distress According to the Kessler Psychological Distress Scale

The dependent variable was nonspecific psychological distress during the past 30 d according to the Kessler Psychological Distress Scale (K6).^{22–24} The K6 consists of 6 items measured on a 5-point scale (0–4): total score ranges from 0 (no distress) to 24 (maximum distress). We defined the presence of psychological distress as 5 points or more of the total K6 score,²³ as used in previous studies.^{25,26} In a secondary analysis, we also used the cutoff point of 13 or more, which is defined as severe psychological distress.

Independent Variable: Factors Potentially Related to Psychological Distress

Based on previous studies,^{12,18} we selected variables potentially associated with psychological distress: (1) demographics, (2) socioeconomic status, (3) school-related factors, and (4) social networks.

(1) Demographics

Demographic variables included age at April 1, 2020 (18, 19, 20, 21, and 22–25 y), sex (men and women), residential prefecture (prefectures under special restrictions in the first declaration of a state of emergency [Tokyo, Kanagawa, Saitama, Chiba, Osaka Hyogo, Fukuoka, Hokkaido, Ibaraki, Ishikawa, Gifu, Aichi, Kyoto] and others), and living status (living alone, living with parents, and others). Age on April 1, 2020, was calculated using registered date of birth.

(2) Socioeconomic Status

In light of the wider context of socioeconomic status, we included a type of higher education institution (private university, public university, professional training college, junior college, and technical college), household income change during the pandemic (increased to >100%, unchanged at 100%, decreased to 50–99%, and decreased to 0–49%), receiving a student loan or scholarship (not received and received), receiving the Special Cash Payment (not received and received), part-time job loss (no, yes, not applicable, and do not know), unpaid wages (no, yes, started pre-pandemic), insufficient money to buy necessities (no, yes, started pre-pandemic), insufficient money to pay school fees (no, yes, started pre-pandemic), and insufficient money to buy food (no, yes, started pre-pandemic).

To determine household income change during the pandemic, we asked the following question: “If your previous household income was set as 100, how has your current household income changed? For example, if it has decreased by half, please answer 50, and if it has doubled, please answer 200.” The range of possible answers was 0 to 200 and “do not know.” We also used the following question to obtain information on unpaid wages, insufficient money to buy necessities, to pay school fees, and to buy food: “Since April 2020, have you had any of the following experiences?” The potential answers were “yes,” “no,” and “started pre-pandemic” for each item. We focused only on the answer of yes and no for ease of interpretation.

Typically, student loans bring in monthly monetary support of approximately 50,000 yen (100 yen \approx 1 US dollar).²⁷ The Special Cash Payment (100,000 yen) in Japan is a financial assistance scheme for all residents, regardless of their financial situation. In 2018, more than 80% of undergraduates had a part-time job.²⁸

(3) School-Related Variables

School closure during the pandemic (no, yes, not applicable, do not know) and attending online lectures (no, yes, not applicable, do not know) were included. To obtain information on school closure, attending online lectures, and part-time job loss (referred to in the socioeconomic status section), we asked the following question: “Around April/May 2020, have you had any of the following experiences?” Participants selected from “yes,” “no,” “not applicable,” and “do not know” for each item. We focused only the on answer of yes and no for ease of interpretation.

(4) Social Network-Related Variable

To determine a frequency of communication with friends and acquaintances by means of email and other messages, we asked “How often have you done each of these in the last month?” with potential answers: “not done,” “once a month,” “2 or 3 times a month,” “once a week,” “2 to 3 times a week,” “4 to 5 times a week,” “almost every day (6 or 7 times a week).” We defined the first answers as “none,” the second and third as “1 to 3 times a month,” and fourth to last as “at least once a week.”

Statistical Analysis

We built 2 Poisson regression models with robust error variance, to calculate prevalence ratios (PRs) and 95% confidence intervals (CIs).²⁹ PRs can be interpreted as relative risks.²⁹ First, we estimated age- and sex-adjusted PRs of each independent variable. Second, we estimated PRs adjusted for all independent variables. Supplemental Table 1 shows the information on missing values in each variable. Supplemental Table 2 shows PRs for severe psychological distress (more than 13 cutoff points). To impute the missing values, we used a k-nearest neighbor imputation (the R package “VIM”) with the assumption of missing at random.³⁰ A *P*-value <0.05 (2-tailed) was considered statistically significant. All analyses were conducted in R (ver. 4.1.0; R Foundation for Statistical Computing, Vienna, Austria).

Results

Table 1 shows the characteristics and psychological distress of the participants in this study. The proportion of psychological distress was 40.0% (383/958). The median age was 20 (1st and 3rd quartile were 19 and 21, respectively) and 56.8% (*n* = 544) were women. Among the participants, 56.4% were private university students, 33.0% public university students, and 10.6% professional training college, junior college, and technical college students. A total of 51.9% experienced decreases in household income, and 39.0% remained unchanged. The percentage of students who lost a part-time job or had unpaid wages was 39.5% and 2.5%, respectively. A total of 5.7% of students had insufficient money to buy necessities, 3.0% had insufficient money to pay school fees, and 4.6% had insufficient money to buy food. School closure occurred among 76.2%, of participants and 84.4% attended online lectures. A total of 16.6% did not communicate with friends and acquaintances by means of email and other messages more than once a week.

Table 2 shows the results from the Poisson regression models after imputation. In the age- and sex-adjusted models, the following factors were associated with an increased proportion of psychological distress: decreasing household income, receiving student loan or scholarship, experiencing unpaid wages, having insufficient money to buy necessities, to pay school fees, or to buy food, and less frequent communication with friends and acquaintances by means of email and other messages. School closure and attendance at online lectures during the pandemic were protectively associated with psychological distress.

In the fully adjusted model, decreases in household income of between 50% and 99% were associated with psychological distress compared with unchanged (PR = 1.48; 95% CI = 1.23, 1.77). Receiving a student loan or scholarship was associated with a PR of 1.27 (95% CI = 1.04, 1.54). Experiencing unpaid wages was associated with an increased risk for psychological distress

compared with not experiencing it (PR = 1.44; 95% CI = 1.07, 1.92). Insufficient money to buy necessities was also associated with a PR of 1.45 (95% CI = 1.07, 1.95) compared with not experiencing it. Compared with communication with friends and acquaintances at least once a week, communication 1 to 3 times a month was associated with an increased risk for psychological distress (PR = 1.22; 95% CI = 1.00, 1.50). School closure during the pandemic was protectively associated with psychological distress (PR = 0.78; 95% CI = 0.63, 0.98).

In the secondary analysis, decreasing household income, insufficient money to buy food, and less frequent communication with friends and acquaintances by means of email and other messages were significantly associated with increased risk for severe psychological distress (Supplemental Table 2).

Discussion

This cross-sectional study showed the proportion of psychological distress according to the K6 was 40.0% among undergraduate students in Japan during the coronavirus disease 2019 pandemic. Experiencing decreasing household income, receiving a student loan or scholarship, experiencing unpaid wages, having insufficient money to buy necessities, to pay school fees, or to buy food, and less frequent communication with friends and acquaintances by means of email and other messages were associated with psychological distress. In contrast, school closure and attendance at online lectures during the pandemic were protective factors for psychological distress.

Economic hardship is considered the most significant predictor for worse mental health among students during the coronavirus disease 2019 pandemic.⁹ Consistent with previous studies, decreasing household income, unpaid wages, having insufficient money to buy necessities, pay school fees, and buy food predicted psychological distress. In particular, the prevalence of decreases in household income was 51.9%, and the PRs for psychological distress were 1.55 and 1.54. Higher education institutions and the government of Japan have already provided financial supports,¹⁴ which might be beneficial to mental health. Although the prevalence of having insufficient money to buy necessities and food was relatively low, the risk for psychological distress was high. Support for providing necessities and food might also be important for students' mental health.

We initially considered that the monthly monetary support from student loans or scholarships would have a positive impact on mental health; however, receiving a student loan or scholarship was associated with psychological distress. In Japan, scholarships are rare, and student loans are the norm.²⁷ In a previous study, student loan was associated with psychological distress after graduation because loan repayment might create a financial burden.²⁷ In the coronavirus disease 2019 pandemic situation, students might have felt uncertain about their future career paths and also be worried about future loan repayment. Furthermore, as students who receive loans are from lower socioeconomic status,²⁷ they might be more vulnerable to the pandemic situation. Additional economic support for students receiving student loans might be useful for their mental health.

School closure and attendance at online lectures during the pandemic were associated with less psychological distress. The Centers for Disease Control and Prevention has warned of a potential to transmit severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) among adolescents attending school although this was still not established.³¹ Graduates in Japan might also feel that

Table 1. Basic characteristics of participants and factors potentially associated with psychological distress

		All eligible participants		Prevalence of psychological distress	
		(n = 958)		(n = 383, 40.0%)	
		n	%	n	%
Age (years old)	18	258	26.9	107	41.5
	19	276	28.8	113	40.9
	20	158	16.5	55	34.8
	21	171	17.8	70	40.9
	22-25	95	9.9	38	40.0
Sex	Men	414	43.2	162	39.1
	Women	544	56.8	221	40.6
Residential prefecture	Prefectures under special restrictions	633	13.2	254	40.1
	Others	325	86.8	129	39.7
Living status	Living alone	341	35.6	126	37.0
	Living with parent(s)	594	62.0	249	41.9
	Others	23	2.4	8	34.8
Type of higher education institution	Private university	540	56.4	224	41.5
	Public university	316	33.0	115	36.4
	Professional Training College, Junior college, and technical college	102	10.6	44	43.1
Household income change during the pandemic	Increased to >100%	39	9.0	12	30.8
	Unchanged at 100%	168	39.0	58	34.5
	Decreased to 50-99%	148	34.3	79	53.4
	Decreased to 0-49%	76	17.6	37	48.7
Receiving a student loan or scholarship	Not received	805	84.0	311	38.6
	Received	153	16.0	72	47.1
Receiving Special Cash Payment	Not received	198	20.7	88	44.4
	Received	760	79.3	295	38.8
Part-time job loss	No	278	29.8	107	38.5
	Yes	369	39.5	151	40.9
	Not applicable	236	25.3	83	35.2
	Do not know	50	5.4	33	66.0
Unpaid wages	No	893	93.2	333	37.3
	Yes	24	2.5	19	79.2
	Started pre-pandemic	41	4.3	31	75.6
Insufficient money to buy necessities	No	856	89.4	308	36.0
	Yes	55	5.7	41	74.5
	Started pre-pandemic	47	4.9	34	72.3
Insufficient money to pay for school fees	No	884	92.3	327	37.0
	Yes	29	3.0	20	69.0
	Started pre-pandemic	45	4.7	36	80.0
Insufficient money to buy foods	No	861	89.9	309	35.9
	Yes	44	4.6	29	65.9
	Started pre-pandemic	53	5.5	45	84.9
School closure during the pandemic	No	107	11.5	55	51.4
	Yes	711	76.2	267	37.6
	Not applicable	80	8.6	28	35.0
	Do not know	35	3.8	24	68.6
Attending online lectures	No	61	6.5	38	62.3
	Yes	787	84.4	297	37.7
	Not applicable	59	6.3	26	44.1
	Do not know	26	2.8	13	50.0
Frequency of communication with friends and acquaintances by means of email and other messages	At least once a week	658	68.7	252	38.3
	One to 3 times a month	141	14.7	72	51.1
	None	159	16.6	59	37.1

Note: Psychological distress was defined as 5 points or more of the total Kessler Psychological Distress Scale (K6).

Table 2. Associations between psychological distress and potentially related factors from Poisson regression models after imputation

		Age- and sex-adjusted model		Fully adjusted model	
		(n = 958)		(n = 958)	
		PR	95% CI	PR	95% CI
Household income change during the pandemic	Increased to >100%	0.86	0.54, 1.37	0.86	0.54, 1.37
	Unchanged at 100%	(reference)		(reference)	
	Decreased to 50-99%	1.55	1.29, 1.85	1.48	1.23, 1.77
	Decreased to 0-49%	1.54	1.23, 1.92	1.22	0.95, 1.57
Receiving a student loan or scholarship	Not received	(reference)		(reference)	
	Received	1.21	1.00, 1.47	1.27	1.04, 1.54
Receiving Special Cash Payment	Not received	(reference)		(reference)	
	Received	0.87	0.73, 1.04	0.93	0.77, 1.12
Part-time job loss	No	(reference)		(reference)	
	Yes	1.06	0.87, 1.28	1.01	0.83, 1.22
	Not applicable	0.89	0.71, 1.12	1.04	0.81, 1.32
	Do not know	1.74	1.36, 2.23	1.35	1.00, 1.81
Unpaid wages	No	(reference)		(reference)	
	Yes	2.14	1.72, 2.66	1.44	1.07, 1.92
	Started pre-pandemic	2.07	1.69, 2.52	0.87	0.62, 1.23
Insufficient money to buy necessities	No	(reference)		(reference)	
	Yes	2.08	1.72, 2.51	1.45	1.07, 1.95
	Started pre-pandemic	2.04	1.66, 2.50	1.11	0.82, 1.50
Insufficient money to pay for school fees	No	(reference)		(reference)	
	Yes	1.87	1.44, 2.44	0.93	0.66, 1.31
	Started pre-pandemic	2.21	1.85, 2.64	1.23	0.89, 1.70
Insufficient money to buy foods	No	(reference)		(reference)	
	Yes	1.83	1.45, 2.31	1.26	0.90, 1.77
	Started pre-pandemic	2.41	2.07, 2.82	1.68	1.23, 2.28
School closure during the pandemic	No	(reference)		(reference)	
	Yes	0.70	0.57, 0.87	0.78	0.63, 0.98
	Not applicable	0.66	0.47, 0.95	0.70	0.46, 1.08
	Do not know	1.34	1.00, 1.78	0.97	0.68, 1.37
Attending online lectures	No	(reference)		(reference)	
	Yes	0.59	0.48, 0.73	0.94	0.70, 1.27
	Not applicable	0.70	0.50, 0.99	1.16	0.75, 1.82
	Do not know	0.81	0.52, 1.26	0.62	0.39, 0.98
Frequency of communication with friends and acquaintances by means of email and other messages	At least once a week	(reference)		(reference)	
	One to 3 times a month	1.34	1.11, 1.62	1.22	1.00, 1.50
	None	0.98	0.78, 1.23	0.93	0.74, 1.17

Note: Fully adjusted model simultaneously includes age, sex, residential prefecture, living status, type of higher education institution, household income change during the pandemic, receiving a student loan or scholarship, Special Cash Payment, part-time job loss, unpaid wages, insufficient money to buy necessities, to pay school fees, to buy food, school closure during the pandemic, attending online lectures, and frequency of communication with friends and acquaintances by means of email and other messages. Psychological distress was defined as 5 points or more of the total Kessler Psychological Distress Scale (K6).

Abbreviations: CI, confidence interval; PR, prevalence ratio.

school closure and attendance at online lectures could decrease the risk of infection, and might be satisfied with the measures. However, in a previous study, students concerned about changing to online lectures had a high risk for depression.¹⁸ Support may still be needed for students who have difficulty adapting to online classes. Our study also showed that students who seldom communicated with friends and acquaintances had an increased risk for psychological distress. As school closure and online lectures are recognized as producing social isolation, support for opportunities to make and communicate with friends might be also effective.

Limitations

This study had 3 limitations. First, as it is cross-sectional, the temporal relationship can be reversed. In addition, we could not assess the changes in independent variables before and after the pandemic. This means that some independent variables might not directly reflect the pandemic's effects on student life. However, in this study, socioeconomic and lifestyle change factors due to the pandemic were also included, which were important predictors of psychological distress. Therefore, our study suggests the impact of difficulties due to the pandemic, as well as just socioeconomic

difficulties. Second, all the information in this study was obtained using the self-administered questionnaire, and some questions were not validated because we did not conduct a pilot study. However, we have been conducting the Japan “Society and New Tobacco” Internet Survey (JASTIS) using similar questions.³² Also, the outcome in this study, the K6 score, has been previously validated.^{22–24} Nevertheless, this study has limitations in relation to the use of self-reports such as misclassification. For example, we determined student status based on the self-administered questionnaire. Furthermore, there was no information on the departments and majors of the students, which might modify the associations. However, these misclassifications are thought to be non-differential to psychological distress. Third, there might be selection bias due to Web recruitment, which means the potential presence of the healthy volunteer effect. In 2020, there were approximately 3.68 million students in higher education.³³ Our study included only 958 undergraduate students, which might include students on leave. Furthermore, among 1030 graduates, just 47 students reported any kinds of mental disorder, which was considerably lower than a nationwide study.³⁴ Furthermore, compared with earlier reports, the proportion of borrowing for student loans was approximately 30% lower.^{27,28} As the study population could have high socioeconomic status, the prevalence of economic difficulties and its risk for psychological distress could be underestimated. Also, previous studies reported the prevalence of psychological distress according to K6 at 5 or higher was 28.5% among medical students²⁵ and 18.4% among first-year students²⁶ during the coronavirus disease 2019 pandemic in Japan. Although the direct comparison is difficult due to the different target populations, the proportion of psychological distress from this study was approximately 10–20% higher than previous studies. We should consider this limitation when interpreting the results of this study.

Conclusions

In conclusion, among undergraduate students in Japan, economic difficulties significantly predicted psychological distress. Empowerment for educational institutions to provide emergency material and mental support to vulnerable students might be needed. In particular, financial support might be effective for students, as experiencing unpaid wages and a decrease in household income were associated with psychological distress. Furthermore, higher education institutions should provide opportunities to communicate with classmates, even if on the Web. Both educational institutions and the general public should recognize the socioeconomic difficulties faced by students and their impact on mental health.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/dmp.2022.245>

Data availability. The data used in this study are not available in a public repository because they contain personally identifiable or potentially sensitive patient information. Based on the regulations for ethical guidelines in Japan, the Research Ethics Committee of the Osaka International Cancer Institute has imposed restrictions on the dissemination of the data collected in this study. All data enquiries should be addressed to the person responsible for data management, Dr. Takahiro Tabuchi at the following e-mail address: tabuchitak@gmail.com

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References

- Haug N, Geyrhofer L, Londei A, *et al.* Ranking the effectiveness of worldwide COVID-19 government interventions. *Nat Hum Behav.* 2020; 4(12):1303–1312. doi: [10.1038/s41562-020-01009-0](https://doi.org/10.1038/s41562-020-01009-0)
- Brooks SK, Webster RK, Smith LE, *et al.* The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet.* 2020;395(10227):912–920. doi: [10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)
- Rajkumar RP. COVID-19 and mental health: a review of the existing literature. *Asian J Psychiatr.* 2020;52:102066. doi:<https://doi.org/10.1016/j.ajp.2020.102066>
- Salari N, Hosseini-Far A, Jalali R, *et al.* Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Global Health.* 2020;16(1):57. doi: [10.1186/s12992-020-00589-w](https://doi.org/10.1186/s12992-020-00589-w)
- Xiong J, Lipsitz O, Nasri F, *et al.* Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord.* 2020;277:55–64. doi:<https://doi.org/10.1016/j.jad.2020.08.001>
- Organisation for Economic Co-operation and Development. OECD economic outlook, Volume 2020 Issue 1. Published online 2020. Accessed December 9, 2022. <https://www.oecd-ilibrary.org/content/publication/0d1d1e2e-en>
- Witteveen D, Velthorst E. Economic hardship and mental health complaints during COVID-19. *Proc Natl Acad Sci U S A.* 2020;117(44):27277–27284. doi: [10.1073/pnas.2009609117](https://doi.org/10.1073/pnas.2009609117)
- Sahu P. Closure of universities due to coronavirus disease 2019 (COVID-19): impact on education and mental health of students and academic staff. *Cureus.* 2020;12(4):e7541–e7541. doi: [10.7759/cureus.7541](https://doi.org/10.7759/cureus.7541)
- Aristovnik A, Keržič D, Ravšelj D, *et al.* Impacts of the COVID-19 pandemic on life of higher education students: a global perspective. *Sustainability.* 2020;12(20). doi: [10.3390/su12208438](https://doi.org/10.3390/su12208438)
- Essadek A, Rabeyron T. Mental health of French students during the Covid-19 pandemic. *J Affect Disord.* 2020;277:392–393. doi: [10.1016/j.jad.2020.08.042](https://doi.org/10.1016/j.jad.2020.08.042)
- Kecojevic A, Basch CH, Sullivan M, *et al.* The impact of the COVID-19 epidemic on mental health of undergraduate students in New Jersey, cross-sectional study. *PLoS One.* 2020;15(9):e0239696. doi: [10.1371/journal.pone.0239696](https://doi.org/10.1371/journal.pone.0239696)
- Wathelet M, Duhem S, Vaiva G, *et al.* Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic. *JAMA Netw Open.* 2020;3(10):e2025591–e2025591. doi: [10.1001/jamanetworkopen.2020.25591](https://doi.org/10.1001/jamanetworkopen.2020.25591)
- Tang W, Hu T, Hu B, *et al.* Prevalence and correlates of PTSD and depressive symptoms one month after the outbreak of the COVID-19 epidemic in a sample of home-quarantined Chinese university students. *J Affect Disord.* 2020;274:1–7. doi: [10.1016/j.jad.2020.05.009](https://doi.org/10.1016/j.jad.2020.05.009)
- Ministry of Education, Culture, Sports, Science and Technology. Survey on the status of support for students affected by the Novel Coronavirus (in Japanese). Published 2021. Accessed March 31, 2021. https://www.mext.go.jp/content/20210216-mxt_kouhou01-000007001-1.pdf

15. **Horita R, Nishio A, Yamamoto M.** The effect of remote learning on the mental health of first year university students in Japan. *Psychiatry Res.* 2021;295:113561. doi: [10.1016/j.psychres.2020.113561](https://doi.org/10.1016/j.psychres.2020.113561)
16. **National Federation of University Co-operative.** Urgent report on undergraduate and graduate students' life survey (in Japanese). National Federation of University Co-operative. Published 2020. Accessed February 3, 2021. <https://www.univcoop.or.jp/covid19/enquete/index.html>
17. **Tsurugano S, Nishikitani M, Inoue M, et al.** Impact of the COVID-19 pandemic on working students: results from the Labour Force Survey and the student lifestyle survey. *J Occup Health.* 2021;63(1):e12209. doi: [10.1002/1348-9585.12209](https://doi.org/10.1002/1348-9585.12209)
18. **Nishimura Y, Ochi K, Tokumasu K, et al.** Impact of the COVID-19 pandemic on the psychological distress of medical students in Japan: cross-sectional survey study. *J Med Internet Res.* 2021;23(2):e25232. doi: [10.2196/25232](https://doi.org/10.2196/25232)
19. **Cabinet Secretariat.** Declaration of a State of Emergency in response to the Novel Coronavirus Disease. Published 2020. Accessed February 12, 2021. https://japan.kantei.go.jp/ongoingtopics/_00020.html
20. **Matsuyama Y, Aida J, Takeuchi K, et al.** Dental pain and worsened socio-economic conditions due to the COVID-19 pandemic. *J Dent Res.* 2021;100(6):591-598. doi: [10.1177/00220345211005782](https://doi.org/10.1177/00220345211005782)
21. **Okubo R, Yoshioka T, Nakaya T, et al.** Urbanization level and neighborhood deprivation, not COVID-19 case numbers by residence area, are associated with severe psychological distress and new-onset suicidal ideation during the COVID-19 pandemic. *J Affect Disord.* 2021;287:89-95. doi: [10.1016/j.jad.2021.03.028](https://doi.org/10.1016/j.jad.2021.03.028)
22. **Kessler RC, Andrews G, Colpe LJ, et al.** Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med.* 2002;32(6):959-976. doi: [10.1017/s0033291702006074](https://doi.org/10.1017/s0033291702006074)
23. **Sakurai K, Nishi A, Kondo K, et al.** Screening performance of K6/K10 and other screening instruments for mood and anxiety disorders in Japan. *Psychiatry Clin Neurosci.* 2011;65(5):434-441. doi: [10.1111/j.1440-1819.2011.02236.x](https://doi.org/10.1111/j.1440-1819.2011.02236.x)
24. **Furukawa TA, Kawakami N, Saitoh M, et al.** The performance of the Japanese version of the K6 and K10 in the World Mental Health Survey Japan. *Int J Methods Psychiatr Res.* 2008;17(3):152-158. doi: [10.1002/mpr.257](https://doi.org/10.1002/mpr.257)
25. **Arima M, Takamiya Y, Furuta A, et al.** Factors associated with the mental health status of medical students during the COVID-19 pandemic: a cross-sectional study in Japan. *BMJ Open.* 2020;10(12):e043728. doi: [10.1136/bmjopen-2020-043728](https://doi.org/10.1136/bmjopen-2020-043728)
26. **Fuse-Nagase Y, Kuroda T, Watanabe J.** Mental health of university freshmen in Japan during the COVID-19 pandemic: screening with Kessler psychological distress scale (K6). *Asian J Psychiatr.* 2020;54:102407. doi: [10.1016/j.ajp.2020.102407](https://doi.org/10.1016/j.ajp.2020.102407)
27. **Sato Y, Watt RG, Saijo Y, et al.** Student loans and psychological distress: a cross-sectional study of young adults in Japan. *J Epidemiol.* 2020;30(10):436-441. doi: [10.2188/jea.JE20190057](https://doi.org/10.2188/jea.JE20190057)
28. **Japan Student Services Organization.** Student life survey 2018 (in Japanese). Published 2018. Accessed June 24, 2021. https://www.jasso.go.jp/about/statistics/gakusei_chosa/2018.html
29. **Zou G.** A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol.* 2004;159(7):702-706. doi: [10.1093/aje/kwh090](https://doi.org/10.1093/aje/kwh090)
30. **Kowarik A, Templ M.** Imputation with the R Package VIM. *J Stat Softw.* 2016;74(7):1-16.
31. **Centers for Disease Control and Prevention.** Science brief: transmission of SARS-CoV-2 in K-12 schools and early care and education programs – updated. In: *CDC COVID-19 Science Briefs.* Centers for Disease Control and Prevention (US); 2020.
32. **Tabuchi T, Shinozaki T, Kunugita N, et al.** Study profile: the Japan “Society and New Tobacco” Internet Survey (JASTIS): a longitudinal internet cohort study of heat-not-burn tobacco products, electronic cigarettes, and conventional tobacco products in Japan. *J Epidemiol.* 2019;29(11):444-450. doi: [10.2188/jea.JE20180116](https://doi.org/10.2188/jea.JE20180116)
33. **Ministry of Education, Culture, Sports, Science and Technology.** School basic survey. Published 2020. Accessed June 24, 2021. https://www.mext.go.jp/b_menu/toukei/chousa01/kihon/kekka/k_detail/1419591_00003.htm
34. **Nishi D, Ishikawa H, Kawakami N.** Prevalence of mental disorders and mental health service use in Japan. *Psychiatry Clin Neurosci.* 2019;73(8):458-465. doi: [10.1111/pcn.12894](https://doi.org/10.1111/pcn.12894)