Original Article

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University students' living conditions during the COVID-19 pandemic and predictors of their subjective health views: A cross-sectional survey

Kiyoshi Hotta[1], Yukihiro Mori[1,2], Makoto Aoike[2], Yukihiro Shigeno[3], Yuka Aoyama[2,4], Mamoru Tanaka[5], Hana Kozai[5], Hatsumi Kawamura[2], Masato Tsurudome[2,6], Morihiro Ito[2,6,*]

[1] Center for Nursing Practicum Support, Chubu University, Aichi, Japan;
[2] Graduate School of Life and Health Sciences, Chubu University, Aichi, Japan;
[3] The Fire Department Headquarters in Kasugai-City, Aichi, Japan;
[4] Department of Clinical Engineering, College of Life and Health Sciences, Chubu University, Aichi, Japan;
[5] Department of Food and Nutritional Sciences, College of Bioscience and Biotechnology, Chubu University, Aichi, Japan;
[6] Department of Biomedical Sciences, College of Life and Health Science, Chubu University, Aichi, Japan.

SUMMARY This study aimed to explore the factors influencing subjective health views based on the living conditions and concerns of university students during the coronavirus infection 2019 (COVID-19) pandemic. From March to April 2021, a questionnaire survey was administered to 8,547 Japanese university students, and logistic regression analysis was used to explore factors related to subjective health views. The results showed that satisfaction with quality of sleep (OR = 2.651, 95% Cl 2.370-2.966, $p < 0.001$), satisfaction with university life (OR = 2.486, 95%Cl 2.215-2.789, $p < 0.001$), satisfaction with diet (OR = 1.849, 95% CI: 1.496-2.285, $p < 0.001$), regular exercise (OR = 1.759, 95% CI: 1.594-1.941, $p < 0.001$), consciousness of nutritional balance (OR = 1.276, 95% CI: 1.147-1.420, $p < 0.001$), eating breakfast every day (OR = 1.247, 95% CI: 1.121-1.387, $p < 0.001$), and consuming soft drinks at least once a week (OR = 0.865, 95% CI: 0.755-0.966, $p = 0.010$) were positive factors for subjective views of health. On the other hand, anxiety about whether the necessary credits can be obtained (OR = 0.885, 95% CI: 0.799-0.980, $p = 0.019$), infection from minimal outings (OR = 0.881, 95% CI: 0.794-0.976, $p = 0.016$) building and maintaining friendships on campus (OR = 0.867, 95% CI: 0.767-0.980, $p = 0.023$), and being able to continue working (OR = 0.713, 95% CI: 0.640-0.795, $p < 0.001$) were identified as negative factors. To ensure a healthy university life during the COVID-19 pandemic or future pandemic, supports tailored to students' living conditions and measures to address their anxieties are required.

Keywords COVID-19 pandemic, university students, subjective health views

1. Introduction

Novel coronavirus infection (COVID-19) was first confirmed in Wuhan, China, in December 2019 (*1*). As at March 10, 2021, 118,496,719 confirmed cases of COVID-19, including 2,726,603 deaths were reported globally. The highly contagious nature of this infection required preventive measures such as wearing masks, physical distancing (*2*), regular washing of hands, use of sanitizers, as well as immediate quarantine and lockdown, all of which are measures that had brought about substantial lifestyle changes and global consequences for students at all levels (*3*). As part of ongoing efforts to further limit the person-to-person transmission of the disease, educational institutions have had to shift to online learning programs. As expected, since not all educators and students were prepared for this sudden change, many did not have adequate access to the appropriate infrastructures and resources. This change in the mode of education has created new and unanticipated challenges for many students (*4*), and in some cases, it has dramatically disrupted the educational process. Many students in tertiary institutions were forced to stay at home and learn the required material on their own. Moreover, they had limited access to learning resources and little or no opportunity for personal

interaction with teachers or classmates. One recent study reported that this situation has led to considerable stress among university students (*4*). Other recent studies revealed increased loneliness, anxiety, and depression due to lockdown, movement restriction, and transition to online learning program during the COVID-19 pandemic (*5,6*). The above sources of stress can have an undesirable impact on learning and may lead to mental health problems (*7*), especially among undergraduate and postgraduate university students, who are the target respondents in this study.

While it is important for different universities to find ways of addressing mental health issues such as anxiety and stress experiences of students during the COVID-19 pandemic (*8*), most universities do not have the infrastructures or resources required to facilitate effective action regarding mental health support for students in these situations. In addition, many universities did not employ specialized mental health counselors during the period (*4*). Ideally, stakeholders of universities should be aware of mental health issues, especially for students who are suffering from mental distress as a result of restrictions or lockdown during the COVID-19 pandemic, and should devise appropriate measures for responding to such situations. Appropriate response actions (*8,9*) can help students to live healthy lives as well as to support their wellbeing, motivate them to study, facilitate effective learning among them during and after the pandemic, and provide emotional stability. Furthermore, most university students in Japan are working adults after graduation and are the leaders of the next generation. However, at the time, research on Japanese university students who experienced the COVID-19 pandemic for one year focused on specific university students, such as depression measurement and nursing students, and there were no comprehensive studies of the situation of students attending comprehensive universities. Therefore, the purpose of this study was to understand the living conditions of university students and to find out the factors influencing their subjective health perceptions one year after the COVID-19 pandemic. We hypothesized that changes in life and anxiety during the COVID-19 pandemic would be influential factors in predicting Japanese university students' subjective views of health.

2. Materials and Methods

2.1. Respondents

This study adopted a cross-sectional study design. The target population of this study was 8,547 undergraduate and postgraduate students of University A. University A is a general university with about 10,000 students, most of them are from different regions in Japan. The survey was conducted from March to April 2021 using a self-administered, anonymous, questionnaire. The survey was conducted during the third to fourth waves of the COVID-19 pandemic in Japan when the state of emergency declaration by the government had been lifted.

2.2. Survey items

All respondents were asked about their sex, age, height, and weight as basic attributes. Data obtained from the respondents were analyzed to compare their basic attributes.

2.2.1. Subjective health views

The respondents were asked to choose between "healthy" and "not healthy" in terms of their subjective health views. Subjective health is defined in this study as a subjective perception of one's own health status, without distinguishing between physical, mental, and social aspects.

2.2.2. Surveys on daily living

The respondents were asked to answer the questions on 11 items that are related to their daily life using a two-response option. The respondents answered "satisfied" or "not satisfied" with their dietary habits, the quality of their sleep, and their university life. They also responded whether they were "aware" or "not aware" of the nutritional balance of foods they took; "substituted" or "not substituted" snacks for meals; "ate" or "did not eat" breakfast daily; "drank" or "did not drink" alcohols at least once in a week; "drank" or "did not drink" soft drinks at least once in a week; "consumed" or "did not consume" healthy foods; slept "more than 7 hours" or "less than 7 hours" a day; and responded "yes" and "no" for regular exercise.

2.2.3. Infection prevention behavior

Respondents were provided with "yes" or "no" options on the following 14 infection-prevention behaviors they are practicing: wearing a mask, washing hands, disinfecting hands, cough etiquette, gargling, avoiding crowds, frequent ventilation, avoiding short-distance conversations, getting enough sleep, gathering information through news, being conscious of their nutritional balance, disinfecting their surroundings, avoiding contact with mucous membranes such as eyes and nose, and using contact confirmation applications. The contact confirmation application (app) was developed by the Ministry of Health, labor, and Welfare and uses the proximity communication function of smartphones to receive notification of the possibility of contact with a positive person while ensuring privacy. The app was developed with the hope that users can receive support from health centers and other institutions

at an early stage by identifying the possibility of contact with an infected person, and that this will help to prevent the spread of infection.

2.2.4. Anxiety factors

The respondents were asked questions about their concerns on the COVID-19 pandemic using two response options of "yes" or "no" for the following 21 items, 6 of which were on lack of a cure, inaccessibility to Polymerase Chain Reaction (PCR) testing, the overwhelmed medical system, possible infection from minimal outings necessary for daily life, uncertainty about how long the COVID-19 pandemic will last, and the possibility of being criticized and discriminated against by others if they become infected. Ten items about student life were: learning and lectures at the university, job seeking, earning credits for graduation, exercises and practical training necessary for the future, participating in internships, acquiring more certificates, financial problems, maintaining and building friendships on campus, organizing university events, and participating in club and volunteer activities. Five items on their future and career path were: whether or not they would be able to find a job, whether or not they would be able to find the type of work they wanted, whether or not they would be able to find a job at the company of their choice, whether or not their place of employment would be stable, and whether or not they would be able to last long in a job.

2.3. Statistical analysis

Data collected were analyzed using descriptive statistics to check proportions. The students' differences in Gender and subjective health views were compared using Pearson's χ^2 test. One-way ANOVA (Games-Howell method) was used to compare the differences in age, height, weight, and BMI. Next, Pearson's χ^2 test was used to determine the differences between "healthy" and "not healthy" responses in the subjective view of health for 11 items of life, 21 items of anxiety, and 14 items of infection prevention behavior. The 21 items of anxiety were also subjected to Pearson's χ^2 test to confirm their association with grade level. Furthermore, a univariate analysis of each item was conducted to confirm the factors influencing subjective views of health, and "getting enough sleep" and "being conscious of nutritional balance" were excluded from the infection prevention behaviors, which overlapped in content. Binomial logistic regression analysis (forward selection (likelihood ratio)) was then conducted with the subjective health views as the dependent variable, and 11 items related to daily life, 12 items related to infection prevention behaviors, and 21 items related to anxiety as independent variables. The respondents' grade was also analyzed as an independent variable to adjust for the effect of grade. All analyses were conducted using SPSS statistics 26 (IBM Corp Armonk. NY. USA), and $p < 0.05$ was considered statistically significant.

2.4. Ethical considerations

Subjects were informed in writing of the purpose, methods, and management of personal information of this study, and their consent was obtained by having them complete a questionnaire. This study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethical Review Committee of Chubu University (approval number 20200095).

3. Results

3.1. Attributes of the target population

A total of 8,117 (95.0%) valid responses were obtained for the study, of which 5,551 (68.4%) were those from males. The percentages of the first-year, second-year, third-year, and fourth-year, and postgraduate students who reported a positive subjective view of health were 59.7%, 46.5%, 48.5%, 49.5%, and 43.2%, respectively. The percentages of second year, third year, and postgraduate students who reported good subjective health were significantly lower than that of the first-year students ($p < 0.001$). There was a significant difference in height between the first- and second-year students ($p = 0.039$). Weight was significantly different for all the first year ($p < 0.001$), second-year ($p < 0.001$), third-year ($p = 0.007$) and fourth-year ($p = 0.004$) compared to postgraduate students, with postgraduate students having a higher weight. Moreover, the first-year ($p = 0.001$) and second-year ($p = 0.001$) students had lower mean BMI values than postgraduate students (Table 1).

3.2. Perceptions and behaviors about life by subjective views of health

Table 2 shows the results of the respondents who responded that they were healthy in the subjective view of health. A total of 4,044 (96.5%) respondents were satisfied with their dietary habits; 3,129 (74.7%) were conscious of their nutritional balance; 2,987 (71.3%) ate breakfast every day; 4,126 (98.4%) replaced their meals with snacks; 796 (19.0%) drank alcohols at least once a week, and 3,026 (72.2%) drank soft drinks at least once a week; 673 (16.1%) consumed health foods at least once a week; 47.1% slept for 7 hours or more; 84.4% were satisfied with their subjective sleep quality; 2,126 (50.7%) exercised regularly, and finally, 3,756 (89.6%) were satisfied with their university life.

The "healthy" group was more likely than the "not healthy" group to answer in the affirmative in the following 8 items: satisfied with their diet, conscious of nutritional balance, eat breakfast every day, substitute

Table 1. Basic attributes of the subjects (*n* = 8,117)

Items	First-year students			Second-year student			Third-year student			Fourth-year student			Postgraduate students			*p*
n (%)	2,595	(32.0)		2,050	(25.3)		1,745	(21.5)		1,528	(18.8)		199	(2.5)		
Gender (Male: %)	1,819	(70.1)	*	1,375	(67.1)		1,229	(70.4)		978	(64.0)		150	(75.4)		< 0.001
Healthy	1,548	(59.7)	*	954	(46.5)	**	846	(48.5)	**	757	(49.5)		86	(43.2)	**	< 0.001
	Mean	*(SD)*		*Mean*	*(SD)*		*Mean*	*(SD)*		*Mean*	*(SD)*		*Mean*	*(SD)*		
Height	167.1	(8.23)		166.4	(8.53)		167.1	(8.33)		166.5	(8.94)		168.3	(8.22)		0.039
Body weight	59.3	(11.28)		58.6	(11.23)		60.3	(11.99)		60.1	(13.28)		63.3	(12.56)		< 0.05
BMI (Kg/m^2)	21.2	(3.26)		21.1	(3.38)		21.6	(3.38)		21.6	(3.87)		22.3	(3.78)		0.001

Gender was compared by the χ^2 test; *, cells with adjusted standardized residuals greater than or equal to +2.0; **, cells with adjusted standardized residuals greater than or equal to -2.0; Age, height, weight, and BMI; Body Mass Index were compared by one-way ANOVA: Games-Howell method.

Table 2. Cross-tabulation by subjective views of health (*n* = 8,117)

Items	Healthy			Not healthy			*p*
	n (%) 4,191 (51.6)			*n* (%) 3,926 (48.4)			
Satisfaction with eating habits	4,044	(96.5)	*	3,504	(89.3)		< 0.001
Consciousness of nutritional balance	3,129	(74.7)	*	2,405	(61.3)		< 0.001
Eating breakfast every day	2,987	(71.3)	*	2,359	(60.1)		< 0.001
Substituting meals with snacks	4,126	(98.4)	*	3,806	(96.9)		< 0.001
Drinking alcohols at least once/week	796	(19.0)		858	(21.9)	*	0.002
Drinking soft drinks at least once/week	3,026	(72.2)		2,987	(76.1)	*	< 0.001
Consumption of healthy foods	673	(16.1)		659	(16.8)		0.385
Sleeping at least 7 hours a night	1,976	(47.1)	*	1,523	(38.8)		< 0.001
Satisfaction with sleep quality	3,538	(84.4)	*	2,376	(60.5)		< 0.001
Regular exercise	2,126	(50.7)	*	1,311	(33.4)		< 0.001
Satisfaction with university life	3,756	(89.6)	*	2,978	(75.9)		< 0.001

χ^2 test, *, cells with adjusted standardized residuals greater than or equal to +2.0.

snacks for meals, sleep 7 or more hours, satisfied with sleep quality, exercise regularly, and satisfied with university life. The percentage of respondents who were satisfied with their university life was high (all $p <$ 0.001). Conversely, the "not healthy" group had higher percentages of those who drank alcohols and soft drinks at least once in a week than the "healthy" group (Table 2).

3.3. COVID-19 pandemic anxiety factors by subjective health views

The respondents were asked about their concerns about the COVID-19 pandemic, student life, and future and career paths (Table 3). The results showed that the "not healthy" group was more likely than the "healthy" group to be concerned about the following 20 items: "lack of a cure" (25.7%), "inaccessibility to PCR testing" (24.5%), "the overwhelmed medical system" (33.9%), " Infection by minimal outings for daily living" (34.4%), "how long the COVID-19 pandemic will continue (38.5%)", and "criticism and discrimination from others when infected" (35.7%). Regarding student life, respondents were concerned about "lectures" (59.2%), "job seeking" (54.7%), "earning credits for graduation" (42.9%), "conducting exercises and practical training" (40.8%), "internships" (33.5%), "acquiring more certificates" (30.0%), "financial problems" (28.0%), "maintaining and building friendships on campus" (25.2%) and "club activities and volunteer activities" (22.6%). As for the future, the respondents were concerned about whether they would be able to find a job (73.9%), get a job they wanted (52.8%), find a job at the company they wanted (35.6%), have a stable job (42.8%), and whether they would be able to last at a job (36.5%) (Table 3).

3.4. Infection prevention behavior

Table 4 shows the infection prevention behaviors currently practiced. Compared to the "healthy" group, the "not healthy" group showed lower implementation rates for the following six items: washing hands (78.2%), gargling (53.7%), avoiding short-distance conversations (21.7%), avoiding contact with mucous membranes such as the eyes and nose (41.6%), getting enough sleep

Table 3. Crosstabulation results of anxiety by subjective views of health (*n* = 8,117)

Items	Healthy			Not healthy			*p*
	n (%)			*n* (%)			
	4,191	(51.6)		3,926	(48.4)		
Anxiety about COVID-19							
Lack of a cure	928	(22.1)		1,008	(25.7)	*	< 0.001
Inaccessibility to PCR testing	865	(20.6)		, 962	(24.5)	*	< 0.001
The overwhelmed medical system	1,204	(28.7)		1,330	(33.9)	*	< 0.001
Infection by minimal outings for daily living	1,222	(29.2)		1,352	(34.4)	*	< 0.001
How long will the COVID-19 pandemic last	1,395	(33.3)		1,512	(38.5)	*	< 0.001
Criticism and discrimination from others	1,290	(30.8)		1,402	(35.7)	*	< 0.001
Anxiety about student life							
Whether lectures will be held	2,323	(55.4)		2,324	(59.2)	*	0.001
Job seeking	2,007	(47.9)		2,149	(54.7)	*	< 0.001
Earning credits for graduation	1,583	(37.8)		1,684	(42.9)	*	< 0.001
Conducting exercises/practical training	1,491	(35.6)		1,603	(40.8)	*	< 0.001
Internships	1,202	(28.7)		1,315	(33.5)	*	< 0.001
Acquisition of qualifications	1,089	(26.0)		1,179	(30.0)	*	< 0.001
Financial problems	950	(22.7)		1,098	(28.0)	*	< 0.001
Maintaining and building friendships on campus	799	(19.1)		989	(25.2)	*	< 0.001
University events	821	(19.6)		810	(20.6)		0.245
Club activities and volunteering activities	858	(20.5)		886	(22.6)	*	0.023
Concerns about employment and career paths							
Getting a job	2,798	(66.8)		2,901	(73.9)	*	< 0.001
Getting a desired job	2,007	(47.9)		2,074	(52.8)	*	< 0.001
Getting a job at a desired company	1,359	(32.4)		1,396	(35.6)	*	0.003
Stability of employment	1,477	(35.2)		1,679	(42.8)	*	< 0.001
Ability to last at a job	1,046	(25.0)		1,434	(36.5)	*	< 0.001

χ^2 test, *, cells with adjusted standardized residuals greater than or equal to +2.0.; COVID-19, coronavirus disease 2019; PCR, polymerase chain reaction.

Table 4. Infection prevention behaviors by subjective views of health (*n* = 8,117)

Items	Healthy			Not healthy			*p*
	n (%)			*n* (%)			
	4,191	(51.6)		3,926	(48.4)		
Wearing a mask	4,120	(98.3)		3,861	(98.3)		0.931
Using water (or basin, *etc*.) for washing hands	3,373	(80.5)		3,069	(78.2)	**	0.011
Gargling	2,579	(61.5)		2,110	(53.7)	**	< 0.001
Hand sanitization	3,173	(75.7)		2,972	(75.7)		0.992
Cough etiquette	2,328	(55.5)		2,215	(56.4)		0.434
Avoiding crowds	2,320	(55.4)		2,139	(54.5)		0.435
Avoiding short-distance conversations	1,027	(24.5)		850	(21.7)	**	0.002
Avoiding touching mucous membranes such as eyes and nose	1,099	(26.2)		890	(41.6)	**	< 0.001
Disinfection of surroundings	1,089	(26.0)		1,010	(25.7)		0.791
Frequent ventilation	1,907	(45.5)		1,735	(44.2)		0.237
Getting enough sleep	1,835	(43.8)		1,156	(29.4)	**	< 0.001
Consciousness of nutritional balance	1,366	(32.6)		895	(22.8)	**	< 0.001
Gathering information from the news, *etc*.	1,507	(36.0)		1,391	(35.4)		0.626
Contact Confirmation App	598	(14.3)	**	636	(16.2)		0.015

χ^2 test, **, items with adjusted residue coefficient less than or equal to -2.0; App, application.

(29.4%), and being conscious of nutritional balance (22.8%).

3.5. COVID-19 pandemic anxiety factors by grade level

Table 5 shows the percentages of respondents who answered "anxious" by grade. Among the items with low values for the first-year students were "lack of cure" (19.6%), "inaccessibility to PCR testing" (19.0%), "overwhelmed medical systems" (27.0%), "infection from outings" (27.8%), "how long it will last" (31.3%), "criticism from others when infected" (29.8%), "job seeking" (35.1%), and "participating in an internship" (21.7%). Others are whether they could find a job

Table 5. Cross-tabulation results of anxiety by grade level for each of the anxiety factors (n = 8,117)

Items	First-year students			Second-year student			Third-year student			Fourth-year student			Postgraduate students			p
	n (%)			n (%)			n (%)			n (%)			n (%)			
	2,595	(32.0)		2,050	(25.3)		1,745	(21.5)		1,528	(18.8)		199	(2.5)		
Anxiety about COVID-19																
Lack of a cure	509	(19.6)	**	1,549	(75.6)		1,284	(73.6)		1,112	(72.8)	*	150	(75.4)		< 0.001
Inaccessibility to PCR testing	493	(19.0)	**	476	(23.2)		421	(24.1)		398	(26.0)	*	39	(19.6)		< 0.001
Overwhelmed medical system	701	(27.0)	**	639	(31.2)		585	(33.5)		536	(35.1)	*	73	(36.7)		< 0.001
Infection from minimal outings for daily living	721	(27.8)	**	666	(32.5)		573	(32.8)		549	(35.9)	*	65	(32.7)		< 0.001
How long will the COVID-19 pandemic last	813	(31.3)	**	751	(36.6)		642	(36.8)		618	(40.4)	*	83	(41.7)		< 0.001
Criticism from others in case of infection	774	(29.8)	**	695	(33.9)		597	(34.2)		565	(37.0)	*	61	(30.7)		< 0.001
Anxiety about student life																
Whether lectures will be held	1,669	(64.3)	*	1,287	(62.8)	*	964	(55.2)		627	(41.0)	**	100	(50.3)		< 0.001
Job seeking	910	(35.1)	**	880	(42.9)	**	1,138	(65.2)	*	1,109	(72.6)	*	119	(59.8)	*	< 0.001
Earning credits	1,303	(50.2)	*	894	(43.6)	*	596	(34.2)	**	438	(28.7)	**	36	(18.1)	**	< 0.001
Conducting exercises and practical training	1,011	(39.0)		860	(42.0)		745	(42.7)		425	(27.8)	**	53	(26.6)	**	< 0.001
Participation in Internships	562	(21.7)	**	515	(25.1)	**	915	(52.4)	*	454	(29.7)		71	(35.7)		< 0.001
Qualifications (including driver's license)	826	(31.8)	*	633	(30.9)	*	516	(29.6)		268	(17.5)	**	25	(12.6)	**	< 0.001
Financial problems	640	(24.7)		539	(26.3)		474	(27.2)	*	336	(22.0)	**	59	(29.6)		0.003
Maintaining and building friendships on campus	750	(28.9)	*	587	(28.6)	*	243	(13.9)	**	181	(11.8)	**	27	(13.6)	**	< 0.001
Organizing University Events	700	(27.0)		540	(26.3)	*	236	(13.5)	**	128	(8.4)	**	27	(13.6)	**	< 0.001
Club activities, circles and volunteering activities	805	(31.0)	*	497	(24.2)	*	266	(15.2)	**	156	(10.2)	**	20	(10.1)	**	< 0.001
Anxiety about the future and career path																
Getting a job	1,649	(63.5)	**	1,459	(71.2)		1,302	(74.6)	*	1,163	(76.1)	*	126	(63.3)	**	< 0.001
Getting the desired job type	1,293	(49.8)		982	(47.9)		910	(52.1)		792	(51.8)		104	(52.3)		0.059
Getting a job at a desired company	717	(27.6)	**	636	(31.0)	**	683	(39.1)	*	640	(41.9)	*	79	(39.7)		< 0.001
Stability of the employment	918	(35.4)	**	833	(40.6)		759	(43.5)	*	575	(37.6)		71	(35.7)		< 0.001
Ability to last on a job	719	(27.7)	**	655	(32.0)		585	(33.5)	*	462	(30.2)		59	(29.6)		0.001

χ^2 test; *, cells with adjusted standardized residuals greater than or equal to +2.0; **, cells with adjusted standardized residuals greater than or equal to -2.0; COVID-19, coronavirus disease 2019; PCR, polymerase chain reaction.

Table 6. Results of binomial logistic regression analysis affecting subjective views of health (*n* = 8,117)

Items	B	symmetric digital subscriber line	OR	95% Cl		*p*
				low	high	
Items related to daily life						
Satisfaction with sleep quality	0.975	0.057	2.651	2.370	2.966	< 0.001
Satisfaction with university life	0.911	0.059	2.486	2.215	2.789	< 0.001
Satisfaction with diet	0.615	0.108	1.849	1.496	2.285	< 0.001
Regular exercise	0.565	0.050	1.759	1.594	1.941	< 0.001
Consciousness of nutritional balance	0.244	0.055	1.276	1.147	1.420	< 0.001
Eating breakfast every day	0.221	0.054	1.247	1.121	1.387	< 0.001
Drinking soft drinks at least once a week	-0.145	0.056	0.865	0.775	0.966	0.010
Items related to anxiety						
Whether or not you can earn credits	-0.122	0.052	0.885	0.799	0.980	0.019
Infection from minimal outings	-0.127	0.053	0.881	0.794	0.976	0.016
Maintaining and building friendships on campus	-0.143	0.063	0.867	0.767	0.980	0.023
Ability to last on a job	-0.338	0.055	0.713	0.640	0.795	< 0.001

Model χ^2 test $p < 0.001$, Hosmer-Lemeshow test $p = 0.003$, Discriminative accuracy 66.9.

(63.5%), whether they could find a job at their desired company (27.6%), whether their job would be stable (35.4%), and whether they would last on a job (27.7%). The items with low scores for the fourth-year students were lectures (41.0%), earning credits (28.7%), doing exercises and practical training (27.8%), acquiring more certificates (17.5%), financial problems (22.0%), maintaining and building friendships on campus (11.8%), holding university events (8.4%) and club activities (10.2%).

3.6. Factors influencing subjective views of health

A logistic regression analysis was conducted to determine the respondents' subjective health view as the dependent variable, 11 items related to life, 12 items related to infection prevention behaviors, 21 items related to anxiety, and grade as the independent variables. As show the Table 6, seven items related to daily life and four items related to anxiety were extracted as factors influencing the subjective view of health. No item related to infection prevention behavior was identified. The items related to life were "satisfaction with the quality of sleep" (OR = 2.651, 95% Cl 2.370-2.966, $p < 0.001$), "satisfaction with university life" (OR = 2.486, 95% Cl 2.215-2.789, $p < 0.001$), "satisfaction with diet" (OR = 1.849, 95% Cl 1.496-2.285, $p < 0.001$), "regular exercise" (OR = 1.759, 95% Cl 1.594-1.941, $p < 0.001$), "consciousness of nutritional balance" (OR = 1.276, 95% Cl 1.147-1.420, $p < 0.001$), "consuming breakfast every day" (OR = 1.247, 95% Cl 1.121-1.387, $p < 0.001$), and "consuming soft drinks at least once in a week" (OR = 0.865, 95% Cl 0.755-0.966, $p = 0.010$). Items related to anxiety were "whether the student will be able to obtain necessary credits" (OR = 0.885, 95% Cl 0.799-0.980, $p = 0.019$), "infection from minimal outings" (OR = 0.881, 95% Cl 0.794-0.976, $p = 0.016$), "maintaining and building friendships on campus" (OR = 0.867, 95% Cl 0.767-0.980, $p = 0.023$), and "whether the student would be able to last on a job" (OR = 0.713, 95% Cl 0.640-0.795, $p < 0.001$) (Table 6).

4. Discussion

In this study, we conducted a questionnaire survey to explore the living conditions of university students and to find out the factors influencing their subjective health perceptions one year after the COVID-19 pandemic. The results revealed living conditions and concerns about COVID-19 during the pandemic, concerns about student life during the COVID-19 pandemic, and specific concerns about the future and career paths. Furthermore, some of these items proved to affect students' subjective views of health. This is the first finding to identify factors related to anxiety and lifestyle related to subjective health views among university students at a comprehensive university in Japan during the COVID-19 pandemic.

The study revealed that the group with lower subjective views of health had lower satisfaction with sleep, diet, and university life, slept less, and did not exercise regularly. Previous studies have also reported that lifestyle changes due to COVID-19 decreased sleep quality and increased snacking and meal frequency (*10,11*). As for exercise habits, many studies have reported a decrease in physical activity due to lockdown (*12*) (*13*). It is likely that the respondents in this study were also affected by the government's declaration of a state of emergency and the switch to online lectures, which resulted in a significant change in their lifestyles. With regard to sleep, it is thought that disruption of sleep patterns due to decreased activity and an increase in the number of late nights may have contributed to the decline in sleep satisfaction (*14*). As for diet, it is possible that the restriction of activities to prevent the spread of infection may have caused changes in diet (*15*). Intriguingly, our result showed that high percentage of the students with high subjective health views proved to substitute meals with snacks. It is not clear whether

the cereal bars, marketed as nutritional supplements, are included in the "snacks" in their answers, though it is reported that increased consumption of cereals with high fruit and protein content during the COVID-19 pandemic may reflect increased health consciousness (*16,17*). Further detailed research is needed in this regard.

Next, we examined anxiety about the COVID-19 pandemic and found that those with low subjective health perceptions were more anxious about COVID-19 but less likely to practice infection-prevention behaviors, such as hand washing and gargling. As for the grade, the fourth-year students were more anxious and the first-year students were less anxious compared to the students of other grades. One possible reason is that young people at that time may have had a false perception that infection does not cause serious illness (*18*). Although this study period was between the third and fourth waves of COVID-19 epidemic in Japan, most of the severe cases were reported among elderly people or people with underlying diseases (*19,20*). Therefore, it is possible that the first-year students did not consider COVID-19 as something that would affect them. It is also possible that the general public understood the necessity of wearing masks and disinfecting their hands, and that the mucous membranes of the nose and mouth could be a route of infection but may not have been fully aware of the risk of infection through irregular hand washing and *via* eyelid mucosa. However, the effectiveness of regular handwashing, eye protection, and physical distance have been shown to decrease infection rates (*2,21*). It has also been reported that poor sleep quality can affect the immune system (*22*). The results of anxiety in students' life depended on the situation of each grade. On the one hand, the first-year students were anxious about the implementation of lectures, obtaining credits, and maintaining and building friendships on campus, similar to the results of the previous study (*23*). On the other hand, the third-year students were anxious about job seeking, internships, and whether they could find a job. At the time of the survey, one year had passed since the onset of the pandemic, and various measures, including remote lectures, were likely implemented so that students could continue their academic activities. However, a certain number of students felt uneasiness about each item, which could be a result of the lack of visibility in the future due to the COVID-19 pandemic. However, the high level of stress associated with social and physical environmental changes and adaptation to a new community is part of university life, in general (*24*). With regard to university students' mental health, the estimated prevalence of mood or anxiety disorders is reported to be 30.6% and is a predictor of depression if left unresolved (*25*). Depression may lead to various health behaviors such as unhealthy eating habits and poor sleep quality (*26*) and may lead to a vicious cycle.

Finally, the results presented here revealed that not only daily living conditions such as diet, sleep, and exercise habits but also anxiety about possible infection even from minimal outings necessary for daily life influenced subjective views of health. Noteworthily, dietary changes due to the COVID-19 pandemic may increase the risk of infection due to reduced immunocompetence caused by nutritional deficiencies (*27*). Previous studies have also indicated that the COVID-19 pandemic is associated with lower nutrient intake and health-related anxiety (*4,28*). It would be necessary to support university students to acquire relevant knowledge such as infection prevention measures to relieve their anxiety about COVID-19 during the pandemic or in the post-COVID-19 era. Furthermore, universities should create a system to support undergraduate and postgraduate students in all aspects of their lives so that they can lead healthy student lives.

Despite the scope covered in this study, there are still some limitations. First, this is a cross-sectional study conducted between the third to fourth major waves of the COVID-19 epidemic in Japan, and there was no comparison of the living conditions of students before and during the COVID-19 pandemic; therefore, it is unclear to what extent living conditions actually changed. Regarding the infection control measures implemented and factors of anxiety, the results may differ depending on the future status of the pandemic and measures such as vaccines and treatments utilized. Therefore, it is necessary to conduct a further survey on the living conditions of university students and the implementation of infection control measures according to the changing situations and concerns about university life in the future. However, the strength of this study is the first to examine whether the living conditions and anxiety of university students attending a comprehensive university in Japan during a pandemic affected their subjective views of health. The findings of this study may be utilized in future interventions to assist university students to lead healthy student lives.

5. Conclusions

This study, conducted during the COVID-19 pandemic, revealed that approximately half of the university students subjectively perceived themselves as unhealthy and had concerns about COVID-19, student life, their employment, and their future. Furthermore, satisfaction with living conditions and anxiety about student life and the future were found to influence the students' subjective health views. This is the first finding of its kind in Japan. The current COVID-19 pandemic provides an important opportunity to consider individualized needs-based supports to help students live a healthy life in the university. Even after the pandemic, it is important to understand the details of the concerns of undergraduate and postgraduate students and to consider support that meets their needs.

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*Address correspondence to:
Morihiro Ito, Department of Biomedical Sciences, College of Life and Health Sciences, Chubu University, 1200 Matsumoto-cho, Kasugai, Aichi 487-8501, Japan.
E-mail: m-ito@isc.chubu.ac.jp

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