Factors related to mental health effect among nursing students in Japan and the United States during the coronavirus pandemic: A cross-sectional study

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ABSTRACT: In the context of mental health, university students have been considered a vulnerable population. However, limited studies have underscored the association between preventive health behaviour levels and mental health effects among nursing students. The current cross-sectional study provides a comparative analysis of the impact of mental health factors on nursing students in Japan and the United States (US) in the context of the coronavirus disease 2019 (COVID-19) pandemic. The study consisted of 878 participants, comprising both undergraduate and graduate nursing students from four universities in Japan, and one from the US. Hierarchical logistic regression was used to analyse the participant data in this study. In contrast to the American students, the Japanese students demonstrated significantly lower levels of perceived control and significantly higher levels of preventive health behaviours. Furthermore, Japanese students exhibited significantly higher levels of stress and/or symptoms of depression induced by the social distancing orders compared to the American students ($z = -4.218$, $P < 0.001$). However, no difference was observed after adjusting for perceived control, individual factors, socio-economic factors, and preventive behaviours. During the pandemic, risk factors that can worsen mental health among the nursing students included younger age [odds ratio (95% CI) = 0.62 (0.48–0.81)], women [OR = 2.17 (1.02–4.61)], higher preventive health behaviour.
Thus, this study recommends establishing training programmes that enhance perceived control and perceived health competence while encouraging preventive behaviour to support the mental health of nursing students, particularly young female students.

**KEY WORDS:** comparative analysis, control beliefs, COVID-19 pandemic, mental health, nursing students.

**INTRODUCTION**

The coronavirus disease 2019 (COVID-19) has had global adverse effects. As of 19 June 2022, 535 million COVID-19 cases have been confirmed, resulting in over 6 million deaths worldwide (World Health Organization (WHO) 2022). Until 2021, the Western Pacific had a relatively low number of cases. However, since early 2022, this amount has increased significantly. To mitigate the transmission of infections, several countries implemented lockdown measures or declared a national emergency, impacting social and academic activities. Lockdown is a security measure taken during an emergency to prevent people from leaving or entering a building or other locations (Dictionary.com 2022), as well as instructions for populations to refrain from going out of their homes for non-essential reasons including the use of stores and facilities (Yamamoto et al. 2020). For example, students had to stay home and engage in online classes.

In the context of mental health, university students are considered a vulnerable population as most of them are transitioning into adulthood and often experience economic and material challenges (Sequeira et al. 2022). Previous studies have underscored the negative mental health effects of COVID-19 on university students (Husky et al. 2020; Sequeira et al. 2022; Zhu et al. 2021). Furthermore, nursing students training to become health professionals experience emotional, social, physiological, psychological, and financial burdens as exacerbated by the pandemic, resulting in burnout. According to a study in China, almost 10% of final-year undergraduate nursing students expressed intentions of leaving the nursing profession after the onset of the pandemic (Nie et al. 2021). In the United States (US), approximately 25% of graduate nursing students reported moderate to extremely severe levels of negative emotional states during the COVID-19 pandemic (Rosenthal et al. 2021). Furthermore, a study in Spain reported that most nursing students were emotionally affected, expressing high levels of anxiety resulting from e-learning (García-González et al. 2021). Moreover, a study conducted in Japan reported that both nurses and nursing students experienced increased fear, anxiety, voluntary restraint, and decreased motivation under the national state of emergency in 2020 (Hasuike et al. 2021).

**BACKGROUND**

A systematic review and meta-analysis (Mulyadi et al. 2021) revealed that during the COVID-19 pandemic, depression (52%), and other COVID-19-related health problems, namely, fear (41%), anxiety (32%), stress (30%), and sleep disturbances (27%) were the most prevalent health problems among nursing students. Thus, Mulyadi et al. (2021) recommend future studies to examine the specific factors associated with mental health problems among nursing students during the COVID-19 pandemic.

Several studies have underscored factors associated with improved preventive health behaviours among nursing students. These factors include individuals who are older, are an upperclassman, are female, possess higher eHealth literacy, live in urban areas, and have a positive attitude towards and good knowledge of COVID-19 (Albaqawi et al. 2020; Yuan et al. 2020), as well as who have longer sleeping hours, have higher health competence, and work shorter hours (Kondo et al. 2021).

Furthermore, perceived control is an important factor influencing improved preventative behaviours and mental health. Perceived control is defined as ‘an individual’s subjective beliefs about the amount of control he or she has over the environment or outcome’. Conversely, ‘actual control describes the objective amount of control the individual has over the environment or outcome’ (Villarreal & Heckhausen 2017, p. 254). Previous studies showed that perceived control was associated with higher preventive behaviours during COVID-19.
pandemic (Kondo et al. 2021; Goodwin et al. 2021). However, increased preventive behaviour was associated simultaneously with deteriorating mental health effects, such as feeling stressed and depressed due to adherence to social distance measures, and exacerbating isolation from society (Kondo et al. 2021). Whereas, a study in China found that lower levels of preventive behaviours among nursing students were associated with higher anxiety (Sun et al. 2020).

A global study \((N = 48\,951)\), which was not specific to the pandemic, found that Japanese people demonstrated the lowest levels of perceived control among 38 nations; meanwhile, the US had higher levels of perceived control than the global average (Hornsey et al. 2019), even though they had a significantly higher infection and death rates than that of Japan and most of the world (WHO 2022). Furthermore, it has been reported that perceived control could buffer the severity of regional psychological effects by moderating the effects of psychological distance among Chinese people (Zheng et al. 2020). Therefore, the difference in the level of perceived control between Japan and the US can impact the mental health of nursing students. Since studies on the association between preventive health behaviour levels and mental health effects among nursing students are lacking, by comparing the factors influencing the mental health of nursing students between Japan and the US and examining the associated factors, this study fills a scholarly gap and may reveal insightful culturally-contextual information to support the mental health of nursing students during the pandemic.

Conceptual framework and definitions

Figure 1 depicts the conceptual framework used in this study based on the combination of Robinson and Lachman’s control model (Robinson & Lachman 2017) and the social–ecological model adapted from the National Institute of Health (e-Source Behavioral & Social Sciences Research n.d.). The control model suggests that sociodemographic factors affect control beliefs, subsequently affecting performance. Using the control model, this study identified sociodemographic factors as the country of origin, socioeconomic status, biological factors, and basic health-related factors. On the other hand, social–ecological model includes multiple levels of influence, such as public policy, community, organizational, interpersonal, and individual factors, where behaviours both shape and are shaped by the social environment. In this study, among sociodemographic factors, country belongs to public policy and community level, socioeconomic status belongs to organizational and interpersonal levels, and basic health-related factors and biological factors belong to individual factors as indicated on the far-left side of the figure.

Control beliefs included perceived control and perceived health competence. Perceived control refers to an integral element of social capital, defined as ‘networks together with shared norms, values, and understandings that facilitate co-operation within or among groups’ (Foxton & Jones 2011; p. 1). Individuals who believe that they have robust control over their behaviours and possess influence over policy decisions impacting their community may achieve more positive health outcomes (Salehi et al. 2016). Perceived health competence was defined as a measure of one’s sense of competence in the domain of health behaviours (Smith et al. 1995). In this sense, while perceived control is more closely related to public policy and community (positioning higher level in the figure), perceived health competence is more on the individual level. Both perceived control and perceived health competence can be affected by sociodemographic factors. Thus, individuals with high control beliefs may then work collectively to improve broader societal or public health outcomes.

Finally, performance was defined as COVID-19 preventive behaviours and mental health effects. Mental health effects were defined as the adverse effects induced by social distancing and stay-at-home measures influencing the nursing students, particularly feelings of stress and/or depression, or feeling alienated from society. These performances can be affected by sociodemographic factors and the two control beliefs.

This study aimed to compare the impact of mental health on nursing students between Japan and the US and examine the relationship between preventative health behaviours and mental health effects, as well as the relationship between perceived control and mental health effects during the COVID-19 pandemic.

The following hypotheses were established:

1. The mental health effect is higher (worse) in Japanese students than in American students.
2. Higher preventive health behaviours are associated with higher (worse) mental health effects.
3. Higher perceived control is associated with lower (improved) mental health effects.
METHODS

Design, setting, and participants

This study comprised of a cross-sectional comparative design including both undergraduate and graduate nursing students from four universities (three private and one national institution) in the metropolitan areas of Tokyo, Japan, and a three-campus public university in the Pacific Northwest region of the US. These participants were selected for survey because of the researchers’ accessibility to the universities. International students were excluded from this analysis to facilitate the comparison of specific cultural differences between Japan and the US.

Data collection

Online questionnaires were administered using Google Forms in Japanese and English for the Japanese and American participants, respectively. The participants were provided with verbal information about the study at the end of classes and/or email invitation to access the Google form that explains the purpose of the anonymous survey, along with the methods, voluntary participation, and observation of privacy. Clicking the ‘Agree’ button on the online survey indicated that the participant had read and consented to participate in the study. Data were collected from November 2020 to May 2021.

Measurements

This study collected information from the participants, namely, sociodemographic data, the perceived control, self-efficacy scale (Salehi et al. 2016) and perceived health competence (Smith et al. 1995) scores, and responses to the preventive health behaviours and mental health effect questionnaire (Kondo et al. 2021).

Sociodemographic data included biological, basic health-related, and socioeconomic factors, besides the country of origin. Biological factors comprised age and sex/gender; basic health-related factors including alcohol intake (i.e. every day, 4–5 times a week, 2–3 times a week, once a week, rarely, and never), smoking status, hours of sleep per day, and any chronic conditions requiring regular check-ups. These variables reflect general health behaviours and have been investigated in previous studies (Kondo et al. 2021; Murray 2013; Salehi et al. 2016; Smith et al. 1995). Finally, socioeconomic factors included academic status (i.e. undergraduate or graduate, domestic or international), possessing a nursing licence, housing situation (i.e. roommate/housemate or none), religious affiliations, and work status (i.e. full-time, part-time, or unemployed).

The perceived control and self-efficacy scale, adapted from the British General Household Survey’s social capital scale, measures perceived influence at both the individual and societal levels (Foxton & Jones 2011). The scale consists of three domains: perceived control over community affairs (four items),
perceived influence over political decisions (four items), and satisfaction with control levels over one’s personal life (two items). We used this scale with the assumption that preventive health behaviours especially during the pandemic could be strongly affected by public policy rather than individual factors. The scale measured 10 items with a five-point Likert scale (strongly disagree, disagree, uncertain, agree, and strongly agree). A sum of the three domains ranged between 10 and 50, with a higher score indicating a higher level of perceived control and self-efficacy over individual and societal matters (Salehi et al. 2016). After obtaining permission from Salehi, initially, the first author translated the scale into Japanese, and then the third author translated it back into English. Thereafter, the first, third, and fourth authors reached a consensus after several discussions and revisions. Cronbach’s alpha of the Japanese version scale was 0.71, which was acceptable (Kondo et al. 2021). In this study, alpha was 0.71 in Japanese students and 0.68 in American students, which were acceptable.

The perceived health competence scale measures the extent to which an individual feels capable of effectively managing his/her health outcomes (Smith et al. 1995), comprising an eight-item instrument measured using a five-point Likert scale (strongly disagree, disagree, uncertain, agree, and strongly agree). This scale contains behavioural expectations and outcomes, with a score ranging from 8 to 40, where higher scores indicate higher health competence. This scale had been translated previously into Japanese, and its reliability and validity were confirmed with 200 residents in Tokyo (94 men and 105 women) aged 20–60 (Togari et al. 2004). Furthermore, permission to use the scale for this study was obtained from its developers and translators. In this study, alpha was 0.71 in Japanese students and 0.68 in American students, which were acceptable.

Lastly, the health behaviour questionnaires comprised of two domains: 17 items related to preventative actions mitigating the transmission of COVID-19 (e.g. wearing a mask in public and avoiding crowded, closed, and close-contact settings.), and two items related to mental health effects. Mental health effect questions assessed whether students (1) experienced stress and/or symptoms of depression induced by adhering to the social distancing (stay-home) measures, and (2) experienced feelings of falling seclusion from society. For both domains, participants were required to select one answer on a scale of 3–0 (3 = always, 2 = often, 1 = sometimes, and 0 = never) for each question. The total score of preventive health behaviour questions ranged from 0 to 51, where higher scores indicate higher levels of practising preventative behaviours. The total mental health effects score ranged from 0 to 6, where higher scores indicated worsening conditions. Initially, the first and second authors created the health behaviour questionnaires based on the Japanese government’s recommendations for preventative protocols (Ministry of Health Labour and Welfare 2021) and Kamenidou et al.’s (2020) questions. And then, the rest of the authors, who were nursing professionals in Japan and US, confirmed the contents and approved that the questions covered necessary preventive health behaviours and mental health effect during COVID-19 after several discussion and revisions (Kondo et al. 2021). The alpha of preventive health behaviours (Japan = 0.80, US = 0.85) were good. Those of the mental health effects were acceptable with 0.72 and good with 0.87 among Japanese and American students, respectively.

Sample size and power

This study used G-Power 3.1.9.7 (Heinrich Heine University of Dusseldorf n.d.) to calculate the sample size. To detect the difference between the main outcome of mental health effects with the effect size of 0.3 by Mann–Whitney test, a total of 574 participants (459 from Japan and 115 from the US) were required. An alpha level of 0.05 (two tails), power of 0.8, and an allocation ratio of 4 (due to accessibility of the universities in both countries) were also used. Approximately 1400 and 1200 students from Japan and the US, respectively, were invited to participate.

Analysis

A chi-square test was used to compare nominal variables (e.g. gender, academic status, and religion) of participant characteristics between two countries. Furthermore, Fisher’s exact test was used to compare smoking status (i.e. ‘yes’ or ‘no’). While the Mann–Whitney U-test was used to compare ordinal variables of work status, frequency of alcohol use, as well as each score (question 1 or 2) and the total score (question one plus 2) of mental health effects. Furthermore, t-tests were performed to compare continuous variables, such as age, sleep duration, as well as the total scores of perceived levels of control, perceived health competence, and preventive health behaviours. The total mental health effect score was divided into two categories,
namely, $\geq 3$ or $3 <$ according to the median, and chi-square tests performed to compare between countries.

Factors associated with the total scores of mental health effects were analysed initially per country before using all data for the bivariate analyses. Spearman's correlation coefficients were used to analyse the association among the total scores of mental health effects, age, work status, frequency of alcohol use, sleep duration, as well as the total score of preventive health behaviours, perceived control, and perceived health competence. Furthermore, either the chi-square test or Fisher's exact test was used to compare mental health effects ($\geq 3$ or $3 <$) between two groups, influenced by gender, academic status, possession of a nursing licence, housing situation, smoking status, and presence of chronic conditions.

Variables related significantly to mental health effects, in either one country or the combined data (i.e. alpha level $<0.05$), were selected for hierarchical multiple logistic regressions with a total mental health effect score ($\geq 3$ or $3 <$) presenting an outcome variable. Independent variables were entered across six levels in the following order, country of origin, individual factors, socio-economic factors, preventive health behaviours, perceived control, and perceived health competence.

Furthermore, the score for question 1 which assessed ‘having stress and/or symptoms of depression induced by social distancing (stay-home) measures’ was significantly higher in Japanese students. Similar hierarchical multiple logistic regression analysis was repeated with the outcome variable of question 1 (1 = always, often, or 0 = sometimes, never), in addition to the analysis of the total mental health score.

Logistic regression assumption includes linearity in the logit for continuous variables, lack of strongly influential outliers, absence of multicollinearity, and independence of errors (Stoltzfus 2011). Linearity in the logit for continuous variables were checked on whether interaction term of each continuous variable and its natural logarithm was significant. Interaction term of age and its logarithm was significantly related to one outcome variable, ‘having stress and/or symptoms of depression induced by social distancing (stay-home) measures’ ($P = 0.022$); therefore, age was categorized into four levels (<19, 20–29, 30–39, and 40 – years). Outliers were checked by z-residual <2 and leverage <0.5. Multicollinearity was checked by Variance Inflation Factor (VIF) <5. Independence of errors was checked by Durbin–Watson value between 1.5 and 2.5.

Model fit was assessed using the Hosmer–Lemeshow test ($P > 0.05$) and Negelkerke $R^2$. Changes ($\Delta$) in Negelkerke $R^2$ were calculated to determine how much each variance level was accounted for. The variables of ‘graduate student’ and ‘possession of nursing licence’ were very similar. However, ‘possession of nursing licence’ was selected because VIF was lower than when ‘graduate student’ was used.

**Ethical considerations**

All procedures contributing to this study comply with the Helsinki Declaration as revised in 2013 and the ethical standards of the relevant national and institutional committees on human experimentation. The Institutional Review Boards (IRBs) of all five participating universities approved this study. Initially, investigations were conducted at three universities in Japan (IRB No. M2020-166; Kondo et al. 2021) before collecting data at two additional universities (IRB No. M2020-171), in Japan and the US (STUDY00012203), respectively.

The students were informed that participation in the study was voluntary, that their answers would not affect or be used for their evaluation, and that they did not have to answer all the demographic questions. However, they were required to answer all the questions for perceived control, perceived health competence, preventative health behaviours, and mental health effects.

All participants could optionally submit their name and email address if they wanted to receive a gift card compensating them for their time and effort. The email addresses of the participants were collected through a Google Form separate from the survey form. Furthermore, gift cards were issued to the participants who expressed their interest.

**RESULTS**

**Participant characteristics**

A total of 896 students responded to the survey invitation (response rates: 52.5% in Japan and 12.1% in the US). Data from 878 (739 Japanese and 139 American) participants were used for the analysis after excluding 18 international students (11 in Japan and 7 in the US). Despite missing demographic data, 878 students’ data were analysed. This study did not use any substituted values for missing data.

Table 1 shows participant characteristics by country. All data except for smoking status were significantly different between the countries. In contrast to the
American students, the Japanese students were younger \((t = 9.01, P < 0.001)\), were mostly female \((\chi^2 = 34.9, P < 0.001)\), did not have their nursing licences \((\chi^2 = 197.1, P < 0.001)\), not religiously affiliated \((\chi^2 = 73.3, P < 0.001)\), worked less \((z = -5.07, P < 0.001)\), did not drink alcohol \((\chi^2 = 23.8, P < 0.001)\), and did not have chronic conditions \((\chi^2 = 17.7, P < 0.001)\). However, perceived health competence \((t = 3.23, P < 0.001)\), and perceived control \((t = 8.86, P < 0.001)\) were significantly lower among Japanese students than American students. Furthermore, total scores of preventive health behaviours were significantly higher \((t = -8.64, P < 0.001)\) among Japanese nursing students than American students.

**Comparison of student mental health effects between the two countries**

Table 2 shows a larger proportion of Japanese students expressed at least three for total score of mental health effects in contrast to American students (62.4% vs 43.9%, chi-square = 16.6, \(P < 0.001\)). Specifically, more Japanese students experienced stress and/or symptoms of depression induced by adhering to social distancing (stay-home) measures (question 1) than American students \((z = -4.22, P < 0.001)\). However, no difference was observed in having feelings of seclusion from society (question 2; \(z = -0.17, P = 0.868\)).

**Table 1 Characteristics of participants (N = 878)**

| Factor                  | Japan (n = 739) | United States (n = 139) | \(n\) | \(P\)-value | Test |
|-------------------------|----------------|-------------------------|------|-------------|------|
| Age, mean (SD)          | 24.3 (8.4)     | 31.3 (8.5)              | 138  | <0.001      | T    |
| Gender, n (%)           |                |                         | 137  | <0.001      | C    |
| Male                    | 26 (3.6)       | 20 (14.6)               | 139  |             |      |
| Female                  | 698 (95.4)     | 116 (84.7)              |      |             |      |
| Transgender             | 0 (0.0)        | 1 (0.7)                 |      |             |      |
| Not prefer to say       | 8 (1.1)        | 0 (0.0)                 |      |             |      |
| Graduate student, n (%) | 182 (24.6)     | 115 (82.7)              | 139  | <0.001      | C    |
| Possess nursing licence, n (%) | 175 (23.7) | 118 (84.9)              | 139  | <0.001      | C    |
| Live with others, n (%) | 581 (80.0)     | 726 (94.2)              | 137  | <0.001      | C    |
| Religious affiliation(s), n (%) | 148 (20.8) | 713 (75.1)              | 126  | <0.001      | C    |
| Work status, n (%)      |                |                         | 137  | <0.001      | M    |
| Full time               | 68 (9.5)       | 59 (43.1)               |      |             |      |
| Part time               | 393 (54.8)     | 34 (24.8)               |      |             |      |
| No work                 | 256 (35.7)     | 44 (32.1)               |      |             |      |
| Drink alcohol, n (%)    | 428 (57.9)     | 101 (72.7)              | 139  | <0.001      | C    |
| Smoking status, n (%)   | 15 (2.0)       | 4 (2.9)                 | 139  | 0.524       | F    |
| Sleep hours, mean (SD)  | 6.7 (1.2)      | 7.2 (1.2)               | 135  | <0.001      | T    |
| Have chronic condition(s), n (%) | 83 (11.2) | 34 (24.5)               | 139  | <0.001      | C    |
| Perceived health competence, mean (SD) | 28.0 (5.8) | 29.7 (4.9)              | 139  | <0.001      | T    |
| Perceived control, mean (SD) | 31.3 (5.1) | 35.4 (4.6)              | 139  | <0.001      | T    |
| Preventive health behaviours, mean (SD) | 41.5 (5.8) | 37.0 (6.1)              | 139  | <0.001      | T    |

C, chi-square test; F, Fisher’s exact test; M, Mann–Whitney U-test; T, t-test.

Factors related to mental health effects of nursing students during the COVID-19 pandemic

Table 3 shows the association between the total mental health effect scores and characteristics per country. Factors related to mental health effects were similar in both countries. Although perceived control was not significant at an alpha level of 0.05 \((P = 0.098)\) in the US due to the limited sample size, \(|p|\) was higher than Japanese students \((-0.141 vs -0.111)\). Furthermore, the only notable difference was that nursing students without a nursing licence in Japan had higher mental health effects than students with a nursing licence \((66.8 vs 45.8%: \text{total sore} \geq 3; P < 0.001)\). While in the US, more students with nursing licences expressed higher, yet insignificant mental health effects \((45.8 vs 33.3%: \text{total sore} \geq 3; P = 0.345)\). Furthermore, fewer alcohol use frequency was associated with increased depression/stress in combined data \((p = -0.070, P = 0.037)\). Based on the bivariate analyses, individual factors of age, gender (biological factors) and frequency of drinking alcohol (basic health-related factor); socio-economic factors of religious affiliations, possession of a nursing licence and work status; and the total scores of preventive health behaviour, perceived control and perceived health competence were selected and were entered into logistic regression.

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Table 4 shows the result of hierarchical logistic regression, which analysed factors related to the total mental health effect score. There was no significant difference in mental health effects between countries after adjusting for individual and socio-economic factors (Step 3). Specifically, when either possessing nurse licence or work status was added, the country variable became insignificant although none of socio-economic factors was significant (Step 3). Higher preventive behaviour was associated significantly with higher mental health effect scores.
TABLE 4 Logistic regression of factors related to mental health effects of nursing students during COVID-19 pandemic in Japan and the US

| Step  | 1               | 2              | 3              | 4               | 5              | 6              |
|-------|----------------|----------------|----------------|----------------|----------------|----------------|
|       | Country        | Add individual factors | Add socio-economic factors | Add preventive health behaviours | Add perceived control | Add perceived health competence |
| Japan (vs the US) | 2.12 (1.47–3.06)*** | 1.54 (1.04–2.28)* | 1.45 (0.90–2.33) | 1.27 (0.78–2.06) | 1.00 (0.60–1.67) | 0.92 (0.55–1.55) |
| Age (10-year categories) | 0.62 (0.52–0.75)*** | 0.66 (0.51–0.85)** | 0.64 (0.50–0.82)*** | 0.61 (0.47–0.79)*** | 0.62 (0.48–0.81)*** |
| Female (vs male) | 2.50 (1.27–4.92)** | 2.46 (1.18–5.10)* | 2.30 (1.10–4.80)* | 2.28 (1.08–4.79)* | 2.17 (1.02–4.61)* |
| Frequency of drinking alcohol | 1.11 (0.97–1.27) | 1.10 (0.95–1.26) | 1.11 (0.96–1.28) | 1.12 (0.97–1.29) | 1.16 (1.01–1.35)* |
| Have religion | 0.96 (0.68–1.36) | 0.95 (0.67–1.35) | 0.97 (0.68–1.39) | 0.95 (0.66–1.36) |                  |
| Possess nurse licence | 0.92 (0.57–1.48) | 0.91 (0.57–1.47) | 0.93 (0.38–1.50) | 0.85 (0.54–1.44) |                  |
| More work | 0.83 (0.66–1.05) | 0.84 (0.66–1.06) | 0.85 (0.67–1.07) | 0.85 (0.66–1.08) |                  |
| Preventive health behaviours |                  | 1.03 (1.01–1.06)* | 1.04 (1.01–1.07)** | 1.05 (1.02–1.08)*** |                  |
| Perceived control |                  |                  | 0.95 (0.92–0.98)*** | 0.97 (0.94–0.99)** |                  |
| Perceived health competence |                  |                  |                  | 0.93 (0.90–0.96)*** |                  |
| Negelkerke $R^2$ | 0.025 | 0.079 | 0.087 | 0.085 | 0.114 | 0.155 |
| ANegelkerke $R^2$ | 0.025 | 0.054 | 0.008 | 0.008 | 0.019 | 0.041 |
| Hosmer & Lemeshow test ($P$-value) | – | 0.627 | 0.671 | 0.674 | 0.114 | 0.968 |

Logistic regression with outcome: Total score of mental health effect $\geq 3$; odds ratio (95% confidence interval); *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. Final model: Variance Inflation Factor of all variables <2.5, Durbin–Watson = 1.993, leverage <0.1.

health effects, despite $R^2$ accounting for only 0.8% (Step 4). When perceived control was added, the Odds ratio of preventive behaviour increased by 1% (Step 5). Perceived control was associated negatively with mental health effects, which accounted for 1.9% of the variance. The association remained significant even after adding perceived health competence (Step 6). Adding the interaction term of country and possessing a nurse licence did not yield significant results and VIF increased over 10 although $R^2$ increased (0.157). Therefore, the interaction term was excluded from the final model. In the final model, factors related to higher mental health effect were younger age [Odds Ratio (95%CI) = 0.62 (0.48–0.81)], female gender [OR = 2.17 (1.02–4.61)], more frequent alcohol drink [OR = 1.16 (1.01–1.35)], higher preventive health behaviour [OR = 1.05 (1.02–1.08)], lower perceived control [OR = 0.97 (0.94–0.99)], and lower perceived health competence [OR = 0.93 (0.90–0.96)]. VIF of all variables were under 2.5. Although there were four cases that had z-residual >2, the highest leverage was 0.057; therefore, the four cases were not excluded.

Factors related to stress/depression of nursing students under COVID-19 pandemic

Table 5 shows the results of the hierarchical logistic regression, which analysed factors related to stress/depression (question 2). After adjusting for individual factors, socio-economic factors, and preventive behaviours, nursing students in Japan demonstrated significantly higher levels of stress/depression (Step 4). When perceived control was added, no differences were observed between countries (Step 5). In the final model, factors associated with higher stress/depression were younger age [OR (95%CI) = 0.74 (0.57–0.95)], female gender [OR = 2.22 (1.05–4.71)], higher preventive health behaviour [OR = 1.03 (1.01–1.06)], and lower perceived health competence [OR = 0.94 (0.91–0.97)] (Step 6). VIF of all variables were under 2.5. Although there were two cases that had z-residual >2, the highest leverage was 0.059; therefore, the two cases were not excluded.

DISCUSSION

This study compared the mental health effects of the COVID-19 pandemic on nursing students in Japan and the US. The Japanese students demonstrated higher mental health effects, particularly stress and/or depression induced by adhering to social distancing measures. However, no difference was observed after adjusting for individual factors, socio-economic factors, preventive behaviours, and control beliefs. The Japanese students exhibited higher preventive behaviour and lower control beliefs, which can be related to higher mental health effects. To our knowledge, this is the first study to compare perceived control, preventative health...
behaviours, and mental health effect between participants from Japan and the US, particularly in the context of the COVID-19 pandemic.

Hypothesis 1 partially supported that the mental health effect was higher in Japanese students. Particularly, Japanese students demonstrated higher stress and/or symptoms of depression upon adhering to social distancing measures. However, no difference was observed in having a feeling of seclusion from society. Staying home induced feelings of stress and/or depression among the participants. However, several methods were available to enable communication with people including social media and online classes, to mitigate feelings of seclusion from society. Furthermore, younger and female students were associated with higher mental health effects, who comprised a higher proportion in this study. This could attribute to the higher mental health effect among Japanese students.

These findings agreed partially with a previous study that found that younger and female university students had an increased susceptibility to mental health degradation before and during the pandemic (Sequeira et al. 2022). Furthermore, Sequeira et al. (2022) reported that limited social support can impact socioeconomic and health outcomes among students as out-of-home students had an increased susceptibility to mental health challenges. However, this study showed that socioeconomic status was not related to mental health effects. One reason could be that students who participated in the study had relatively similar socioeconomic conditions and the difference was too insignificant to be detected.

Hypothesis 2 supported that higher preventive health behaviours were associated with higher (worse) mental health effects. Japanese students showed significantly higher preventative health behaviours than American students, which could attribute to the higher mental health effect in Japanese students. Furthermore, Zhao et al. (2020) reported that female students exhibited more severe depressive symptoms than male students. While preventive behaviours were higher among female students, committing preventive health behavioural practices can inevitably restrict one’s freedom, thus affecting individual mental health and causing conditions such as isolation and depression (Zhao et al. 2020). However, when perceived health competence was added, the Odds Ratio of female decreased in both models (Tables 4 and 5), which indicates that mental health effects can be lower if female students showed higher levels of perceived health competence.

Upon adjusting for preventive health behaviour, stress and/or depression in Japanese students was still approximately double the rate in American students, suggesting that when preventive health behaviour is at the same level, Japanese students have more stress and/or depression. After adjusting for perceived control, no significant difference was observed between the countries for stress and/or depression. These findings indicate that if the level of the perceived control is the same, no difference in stress and/or depression levels would be observed between the countries. Similarly, Zheng et al. (2020) indicated that perceived control can buffer the mental health consequences of preventive health behaviours.

Hypothesis 3 supported that higher perceived control was associated with lower (improved) mental health effects, despite the weakened association after controlling for perceived health competence. Both perceived control and perceived health competence were significantly lower in Japanese students than in American students, perhaps justifying the higher mental health effects among Japanese students. The total $R^2$ score for control beliefs was higher than the total score of individual factors (0.054 vs 0.019 + 0.041 = 0.060 for the total score of mental health effects, 0.035 vs 0.012 + 0.031 = 0.043 for stress and/or depression). Lower perceived control of Japanese students was consistent with previous study findings (Hornsey et al. 2019). Moreover, lower levels of perceived control in Japanese individuals could be related to the unique Japanese culture of valuing networks, such as respecting others’ feelings and wishes and conforming instead of individualism (Hornsey et al. 2019). Furthermore, Japanese culture accentuates the importance of modest expressions and self-evaluations of low power to survive harmoniously in a collectivist society (Yamagishi et al. 2012). Despite the low percentage of chronic conditions among Japanese students, a significantly lower level of perceived health competence was observed. Villarreal and Heckhausen (2017) defined perceived control as subjective as opposed to actual control. Thus, Japanese students perceive low levels of their ability to control, resulting in higher mental health effects, particularly stress/depression.

The Global Gender Gap Index ranked Japan and the US 121st and 53rd, respectively, out of 153 countries (World Economic Forum 2020). Besides Japan’s modest culture, social status and political power among females in Japan are lower, which could justify the lower perceived control of female students.
**TABLE 5** Logistic regression of factors related to stress/depression among nursing students in Japan and the US during the COVID-19 pandemic

| Step | Country          | Add individual factors | Add socio-economic factors | Add preventive health behaviours | Add perceived control | Add perceived health competence |
|------|------------------|------------------------|---------------------------|---------------------------------|----------------------|-------------------------------|
| 1    | Japan (vs US)    | 2.90 (2.00–4.21)**     |                          |                                 |                      |                               |
|      | Age (10-year categories) | 0.70 (0.58–0.85)**     | 0.76 (0.59–0.97)*        | 0.74 (0.58–0.96)*                | 0.72 (0.59–0.99)*    | 0.74 (0.57–0.95)*             |
|      | Female (vs male) | 2.47 (1.25–4.89)**     | 2.43 (1.17–5.06)*        | 2.35 (1.12–4.92)*                | 2.34 (1.11–4.93)*    | 2.22 (1.05–4.71)*             |
|      | Frequency of drinking alcohol | 1.06 (0.93–1.22)     | 1.05 (0.92–1.21)        | 1.06 (0.92–1.22)                | 1.07 (0.92–1.23)    | 1.10 (0.95–1.27)              |
|      | Have religion    | 0.59 (0.62–1.26)       | 0.58 (0.62–1.25)        | 0.90 (0.63–1.28)                | 0.98 (0.62–1.26)    |                               |
|      | Preventive health behaviours | 0.84 (0.52–1.35)     | 0.84 (0.52–1.35)        | 0.85 (0.53–1.37)                | 0.94 (0.50–1.31)    |                               |
|      | More work        | 0.88 (0.70–1.12)       | 0.89 (0.70–1.12)        | 0.90 (0.71–1.14)                | 0.90 (0.71–1.15)    |                               |
|      | Perceived control| 1.01 (0.99–1.04)       | 1.02 (0.99–1.05)        | 1.03 (1.01–1.06)*               | 0.96 (0.93–0.99)**  | 0.97 (0.94–1.00)              |
|      | Perceived health competence | –                   |                           |                                 |                      | 0.94 (0.91–0.97)**          | 0.97 (0.94–1.00)              |
|      | Nagelkerke $R^2$ | 0.049                  | 0.084                    | 0.094                           | 0.096                | 0.108                         | 0.139                         |
|      | ANagelkerke $R^2$| 0.049                  | 0.035                    | 0.010                           | 0.002                | 0.012                         | 0.031                         |
|      | Hosmer & Lemeshow test (P-value) | –                   | 0.237                    | 0.141                           | 0.452                | 0.656                         | 0.170                         |

Logistic regression with outcome: Experience stress and/or symptoms of depression induced by adhering to social distancing (stay-home) measures (1 = always, often, 0 = sometimes, never); odds ratio (95% confidence interval); *P < 0.05, **P < 0.01, ***P < 0.001. Final model: Variance Inflation Factor of all variables <2.5, Durbin–Watson = 2.027, leverage <0.1.

Limitations and future studies

The generalizability of this study could be limited as convenient samples were used, and the response rate among US students was very low. This study reported factors significantly associated with mental health effects. However, the low $R^2$ indicated that there may be unknown factors related to mental health effects. Furthermore, this was a cross-sectional study, thus the cause-effect relationships among the variables were not justified. Therefore, future studies should investigate how young Japanese adults’ perceived control affects their mental health as they age. Furthermore, future studies should determine if perceived control can be increased through training. Despite the low $R^2$ score, the total $R^2$ score of control beliefs was higher than the total score of individual factors. Thus, the effect of control beliefs should not be overlooked, and future studies should determine the necessity of increasing control beliefs. Furthermore, studies should increase the sample sizes and broaden the different levels of perceived control. Future studies should investigate whether the gender gap is related to perceived control and mental health.

**CONCLUSION**

In contrast to US students, the Japanese students demonstrated higher mental health effects, particularly stress and depression induced by adhering to the social distancing measures. However, no difference was observed after adjusting for individual factors, preventive behaviours, and perceived control. Furthermore, higher levels of preventive health behaviours were associated with higher mental health effects. While higher levels of perceived control were associated with lower mental health effects. The results of this study can be utilized in improving educational programmes for students to have more control beliefs not only at university but also at high school or even elementary school.

**RELEVANCE FOR PRACTICE**

Risk factors for poorer mental health during the COVID-19 pandemic included nursing students with lower levels of both perceived control and perceived health competence. Thus, this study recommends promoting ways for nursing students to achieve a sense of control, particularly in their health and personal life, despite not having or expressing actual control. For example, ‘political science’ can be a required subject in the first year of the nursing curriculum (currently elective in Japan), where students learn importance of having interest in policy and sense of control, which is closely related to people’s health. Association between control belief and health can also be introduced in the subject ‘health promotion education’. In this way, more students will be aware about policy and
understand the importance of preventive health behaviours, which government encourage people to do to prevent infection.

Furthermore, as the majority of nursing students are female, adequate support and care (e.g. regular individual communication with faculty members and counselling with health care staff to prevent mental effect and/or find it early) ought to be provided to younger female nursing students, who face an increased risk of negative mental health effects. Creating opportunities for students to share their experiences related to their challenges during the pandemic using online tool may also be helpful to decrease social isolation. In addition, more education to empower female students from younger age and social system to support women should be necessary in Japan.

ETHICAL APPROVAL

All procedures contributing to this study comply with the Helsinki Declaration as revised in 2013 and the ethical standards of the relevant national and institutional committees on human experimentation. The Institutional Review Boards (IRBs) of all five participating universities approved this study. Initially, investigations were conducted at three universities in Japan (IRB No. M2020-166) before collecting data at two additional universities (IRB No. M2020-171) in Japan, and the US (STUDY00012203), respectively.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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