



Original Article

## Correlation between psychological stress and depressive symptoms among Japanese university students: a cross-sectional analysis

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**Abstract.** [Purpose] Higher education students face significant environmental changes, placing them at heightened risk of developing depressive symptoms that have been exacerbated by the coronavirus infectious disease pandemic. This study examined the association between psychological stress and depressive symptoms among Japanese university students. [Participants and Methods] We conducted an online and face-to-face questionnaire survey with 145 Japanese university students studying rehabilitation sciences. Depressive symptoms and psychological stress were evaluated using the Self-rating Depression Scale and Stress Response Scale-18, respectively. [Results] Among the participants, 88 had depressive symptoms. Compared to the non-depressive symptom group, the depressive symptom group experienced higher psychological stress and comprised significantly more women and individuals with insomnia. Logistic regression analysis revealed that psychological stress and insomnia were independent predictors of depressive symptoms. [Conclusion] Psychological stress is independently associated with depressive symptoms. The correlation between insomnia, stress, and depressive symptoms requires further investigation. Future research should explore the causal relationship between psychological stress and depressive symptoms and consider the factors that may influence this relationship.

**Key words:** Psychological stress, Depressive symptoms, University students

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### INTRODUCTION

College students are at a major turning point in their lives and experience changes in their living environments and economic situations<sup>1, 2)</sup>. They are considered to be at the peak of risk for the first onset of depressive symptoms<sup>1)</sup>. Approximately 39% of college students experience depressive symptoms<sup>3)</sup>. The prevalence of depressive symptoms among college students has long been a problem and increased during the outbreak of the novel coronavirus disease 2019 (COVID-19)<sup>4-6)</sup>, particularly because of the academic anxiety and loneliness caused by the shift from in-person to distance learning<sup>5)</sup>. Depressive symptoms in college students can lead to poor academic performance<sup>7)</sup>, illegal drug use<sup>8)</sup>, and increased suicidal ideation and suicide rates<sup>9)</sup>. This highlights the importance of implementing preventive and therapeutic measures against depression.

Identifying factors that are strongly associated with depressive symptoms and that can alleviate depression can aid in the development of preventive and therapeutic interventions. Various factors have been linked to depressive symptoms, including genetic and environmental conditions<sup>10, 11)</sup>. In addition, psychological stress has been considered an important factor. A previ-

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ous study revealed that many college students experience psychological stress caused by academic burdens and changes in their living environment (lifestyle)<sup>12</sup>. However, psychological stress has been shown to be ameliorated by physical activities such as yoga<sup>13</sup> and cognitive behavioral therapy<sup>14</sup>. This suggests that psychological stress may be ameliorated by physical therapy. Therefore, once the association between psychological stress and depressive symptoms is established, psychological stress can be a therapeutic target for physical therapy to prevent or reduce depressive symptoms in college students.

Past studies have not investigated the association between psychological stress and depressive symptoms among university students in addition to many other related factors associated with depression among this population. Previous research involving college and medical students has demonstrated an association between psychological stress and depressive symptoms. However, the relationship between psychological stress and depression is intricate, and certain aspects remain unclear<sup>17</sup>. Furthermore, depression is an affective disorder that is likely influenced by multiple factors<sup>10, 11</sup>. Although Liu et al.<sup>15</sup> and Sprung and Rogers<sup>16</sup> briefly discussed these factors, they did not adequately address their role in depression. Among college students, depressive symptoms have been associated with physical activity<sup>6</sup>, sleep<sup>15</sup>, skeletal muscle mass<sup>18</sup>, grip strength<sup>19</sup>, chronic pain<sup>20</sup>, health literacy<sup>21</sup>, and alcohol consumption<sup>22</sup>. By taking these factors into account, clarifying whether psychological stress is associated with depressive symptoms may provide important information on whether approaches to psychological stress can prevent or ameliorate depressive symptoms. Thus, this study aimed to determine whether psychological stress, as well as other multiple factors, are associated with depressive symptoms in Japanese university students.

## PARTICIPANTS AND METHODS

This study used a cross-sectional design<sup>12</sup>. The participants were students aged 18 years or older studying rehabilitation medicine at a university in Japan. They had no pre-existing psychiatric disorder and were independent in daily living. Written informed consent was obtained from the students before participating in the study. Those participants who did not provide complete data on the survey questionnaire were excluded from the study. The study protocol was approved by the institutional review board (ethics number: 21018) and conducted according to the Declaration of Helsinki.

The study methods included in-person assessment and an online survey. Anthropometric evaluation was conducted in person and a web-based survey was conducted using quick-response codes. The web-based survey method and face-to-face evaluations were explained to the participants by either the principal investigator or research collaborator.

Depressive symptoms were assessed using the Self-Rating Depression Scale developed by Zung<sup>23</sup>. The scale consists of 20 items that are rated on a 4-point scale: “rarely”=1 point, “sometimes”=2 points, “often”=3 points, and “always”=4 points. The total score ranges from 20 to 80 points, with higher scores indicating the more frequent and severe the depressive symptoms. Scores of 40 points or higher indicate tendencies toward depression<sup>24</sup>. Furthermore, sensitivity and specificity were satisfactory when a score of 40 was used as the cutoff.

Psychological stress was considered “the exposure factor” and was assessed using the Stress Response Scale-18 (SRS-18), developed in Japan to measure stress reactions in daily life<sup>25</sup>. The scale consists of 18 items (e.g., “I feel anxious”, “I feel sad”, “I feel short-tempered”, and “I have difficulty concentrating”), and each item is rated on a 4-point scale: “not at all”=0, “somewhat true”=1, “fairly true”=2, and “true”=3. The higher the score, the stronger the psychological stress reaction. The internal consistency of the scale in the general population ranged from  $\alpha=0.82$  to 0.88, and structural equation modeling demonstrated that a three-factor model was a good fit<sup>25</sup>.

The related sociodemographic factors included in this study were age, gender, alcohol consumption, part-time employment or lack thereof, chronic pain, and living alone or with others. Other related factors included insomnia, sleep disorder, general health literacy, pain catastrophizing, body fat mass, skeletal muscle mass index, grip strength, and total physical activity per week.

Insomnia was assessed using the Athens Insomnia Scale, a questionnaire that asks respondents to answer eight sleep-related questions rated on a 4-point scale. Each item is scored from 0 to 3 points. The total score is used to determine the degree of insomnia, and total scores of 0–3, 4–5, 6–9, and 10 or more points indicate “no problem with insomnia”, “slight suspicion of insomnia”, “suspicion of insomnia”, and “recommendation to consult a specialist”, respectively<sup>26, 27</sup>. A total score of 6 or more is considered an indication of insomnia<sup>28</sup>. The Japanese version of the scale demonstrated good internal consistency, reliability, and sufficient validity<sup>26</sup>.

Sleep disorders were assessed using the Japanese version of the Pittsburgh Sleep Quality Index<sup>29</sup>, which comprises questions about sleep quality, the time of falling asleep, sleep duration, and the use of sedatives. Items are responded to using a 4-point scale (0–3 points), with scores ranging from 0 to 21 points<sup>2</sup>. A total score of 6 or higher indicates the presence of a sleep disorder. Doi et al.<sup>29</sup> demonstrated support for the reliability and validity of the Japanese version of the scale.

General health literacy was assessed using the European Health Literacy Survey Questionnaire, which includes specific competencies such as accessing, understanding, evaluating, and applying health information in health care, disease prevention, and health promotion<sup>30</sup>. The items are responded to using a 4-point Likert scale: “very difficult”=1, “somewhat difficult”=2, “somewhat easy”=3, and “very easy”=4. Total scores, which range from 0 to 50 points, are calculated using the following formula: (mean of responses - 1) × (50/3). The higher the score, the higher the level of general health literacy. Nakayama et al.<sup>31</sup> confirmed the reliability and validity of the Japanese version of the European Health Literacy Survey Questionnaire.

Pain catastrophizing was measured using the Pain Catastrophizing Scale (PCS), which consists of three subscales: Ruminative, Helplessness, and Magnification<sup>32</sup>). The PCS measures responses to 13 pain-catastrophizing questions using a 5-point scale. Total scores range from 0 to 52, with higher scores indicating greater pain catastrophizing. The Japanese version of the PCS demonstrated high internal consistency reliability<sup>33</sup>).

Body fat mass and skeletal muscle mass index were assessed using the Body Planner TM DF870 (Daiwa Scale Co., Ltd., Hyogo, Japan). All measurements were taken in a standing position and the duration was not specified.

Grip strength was measured twice for each hand using a GRIP-D digital grip strength meter (Takei Kiki Kogyo Co. Ltd., Niigakata, Japan). In this study, the maximum grip strength value was used regardless of whether it was for the right or left hand.

Physical activity was measured using the International Physical Activity Questionnaire, which measures the frequency, duration, and intensity of physical activity during the past week and calculates the amount of physical activity<sup>34</sup>). The questionnaire includes 31 items and has demonstrated good criterion-related validity and reliability with measurements of physical activity by accelerometers<sup>35</sup>). The total physical activity (the sum of physical activity related to walking, moderate physical activity, and strong physical activity) items for one week were used in this study.

Using the Self-Rating Depression Scale score, participants with more than or less than 40 points were classified into depressive or non-depressive symptom groups, respectively. To compare the exposure and related factors between the two groups, unpaired t-tests and chi-square tests were conducted. Next, to clarify whether psychological stress was independently associated with depressive symptoms, logistic regression analysis (forced entry method) was performed with depressive symptoms as the dependent variable (no depressive symptoms, 0; depressive symptoms, 1). The independent variables were those variables that showed significant differences on the SRS-18 in the univariate analyses. IBM SPSS software version 24 was used for all statistical analyses. The significance level was set at 5%.

## RESULTS

Of the initial 172 students recruited for the study, 13 did not provide consent and 14 who had missing data were excluded from the analysis. Consequently, the final sample comprised 145 participants, all included in the final analysis. Table 1 presents the basic attributes of the participants.

Eighty-eight participants (60.7%) were classified as the depressive symptom group. A comparison between the depressive and non-depressive symptom groups is presented in Table 1. The depressive symptom group comprised more women than men ( $p=0.027$ ) and had significantly higher SRS-18 scores ( $p<0.001$ ), PCS scores ( $p<0.001$ ), Athens Insomnia Scale scores ( $p<0.001$ ), and lower European Health Literacy Survey Questionnaire scores ( $p=0.002$ ) than the non-depressive symptom group.

**Table 1.** A comparison between the factors of the depressive symptoms and non-depressive symptoms groups

	All (n=145)	Depressive symptoms groups (n=88)	Non-depressive symptoms groups (n=57)
Stress response scale-18, points***	13.1 ± 11.0	18.3 ± 10.7	5.1 ± 5.3
Female, n (%)*	78 (53.8)	54 (61.4)	24 (42.1)
Age, years	20.3 ± 1.1	20.3 ± 1.2	20.3 ± 1.1
Body mass index, kg/m <sup>2</sup>	20.7 ± 2.8	20.6 ± 3.0	21.0 ± 2.8
Alcohol consumption, n (%)	75 (51.0)	44 (50.0)	30 (52.6)
Part-time job or not, n (%)	107 (73.8)	65 (73.9)	42 (73.9)
Living alone or not, n (%)	35 (24.1)	21 (23.9)	14 (24.6)
Chronic Pain, n (%)	28 (19.3)	17 (19.3)	11 (19.3)
Insomnia, n (%)***	37 (25.5)	36 (40.9)	1 (1.7)
Sleep disorder, n (%)	59 (40.7)	40 (45.5)	19 (33.3)
European health literacy survey questionnaire, points**	29.4 ± 8.6	27.5 ± 7.8	31.9 ± 8.8
Pain catastrophizing scale, points***	15.3 ± 11.8	18.5 ± 10.9	10.5 ± 11.5
Body fat mass, kg	12.4 ± 5.5	12.5 ± 5.7	12.4 ± 5.3
Skeletal muscle mass Index, kg/m <sup>2</sup>	6.3 ± 1.1	6.3 ± 1.2	6.4 ± 1.0
Grip strength, kg	34.0 ± 9.8	33.3 ± 9.8	35.0 ± 8.6
Total physical activity per week (IPAQ), METs×minutes	4,229.3 ± 6,823.7	4,264.1 ± 7,702.2	4,684.4 ± 5,240.2

Average ± standard deviation.

\* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ .

The results of the logistic regression analysis are presented in Table 2. Scores on the SRS-18 (odds ratio 1.184; 95% confidence interval: 1.099–1.276;  $p < 0.001$ ) and Athens Insomnia Scale (odds ratio 15.665; 95% confidence interval: 1.721–142.572;  $p = 0.015$ ) were independent factors significantly associated with depressive symptoms (Table 2).

## DISCUSSION

This study examined whether psychological stress was associated with depressive symptoms among Japanese university students. The results showed that psychological stress was significantly and independently correlated with depressive symptoms, even when multiple factors associated with depression were accounted for. Furthermore, insomnia was independently associated with depressive symptoms.

Previous studies<sup>15, 16</sup> have reported that psychological stress is associated with depressive symptoms among college students, and the present results support this finding. However, Liu et al.<sup>15</sup> evaluated only three outcomes (psychological stress, insomnia, and depression) and did not consider other possible related factors. Sprung and Rogers<sup>16</sup> investigated seven related variables, including depression, anxiety, stress, and work hours, but did not consider other related factors that may influence depressive symptoms. The present study included factors that were not investigated in past research, such as skeletal muscle mass index, health literacy, physical activity, and alcohol consumption. The results are noteworthy because they revealed that psychological stress may contribute to depressive symptoms in university students beyond the effects of multiple related factors.

Psychological stress is associated with depressive symptoms through several mechanisms. Depression has been reported to be closely related to the activation of inflammatory molecules via chronic stress<sup>36</sup>, and levels of inflammatory molecules such as IL-6, CRP, and IL-1 $\beta$  are higher in depressed patients<sup>37</sup>. Furthermore, psychological stress may exacerbate inflammatory responses, leading to depression. Research suggests that p11 is a significant molecule in the regulation of stress and depression<sup>38</sup>; it is a protein that binds to serotonin receptors<sup>39</sup> and may induce depression by being attenuated by stress exposure<sup>38</sup>. Although the present study could not clarify whether and how psychological stress is related to depressive symptoms, the mechanism by which psychological stress affects depressive symptoms has been considered. The present findings suggest a promising avenue for future research, focusing on a comprehensive exploration of the association between stress and depressive symptoms.

Insomnia was also found to be associated with depressive symptoms, which is consistent with the findings of a previous study on depression in college students<sup>40</sup>. Approximately 17–22% of college students have insomnia<sup>40, 41</sup>, which is known to be strongly associated with depressive symptoms<sup>42</sup>. Furthermore, meta-analysis studies showed that the risk of depression in patients with insomnia increased by two-to-three-fold<sup>43, 44</sup>. Although there are many unknowns regarding the association between sleep disorders, such as insomnia, and depression<sup>45</sup>, a recent study reported that genetic variants shared between depression and insomnia were observed in the cerebral cortex, frontal cortex, anterior cingulate cortex, and cerebellum of patients with depression and insomnia<sup>46</sup>. Furthermore, dysregulation of glutamate and gamma-aminobutyric acid in the cerebral cortex has been observed in patients with depression and insomnia<sup>47, 48</sup>. Insomnia, a stress behavior, also promotes chronic activation of the hypothalamic-pituitary-adrenal axis and may play an important role in the development of depression<sup>49, 50</sup>. Thus, although this study could not clarify why depression and insomnia are associated, the results of the association between insomnia and depressive symptoms in the present sample are valid.

Relatedly, this study has the advantage of considering the influence of multiple associated factors—a gap unaddressed by prior studies. Depression is a multifactorial affective disorder with complex mechanisms; thus, the results of studies that do not fully consider related factors may not be able to determine if they are true factors for depressive symptoms<sup>10, 11</sup>. The present findings, although not all, suggest that psychological stress is associated with depressive symptoms, even after accounting for several associated factors of depressive symptoms. This is an important finding for future research.

There are three limitations to this study. First, the study used a cross-sectional design; therefore, psychological stress may have increased because of depressive symptoms. A prospective cohort study should be conducted to examine if there is a causal relationship between psychological stress and depressive symptoms. Second, this study was conducted only on students at one university in Japan, resulting in a sample size small that limits the generalizability of the results. Moreover,

**Table 2.** Logistic regression analysis

	B	Odds ratio	95% Confidence interval
Stress response scale-18**	0.169	1.184	1.099–1.276
Sex	0.085	1.089	0.427–2.777
Insomnia*	2.751	15.665	1.721–142.572
European health literacy survey questionnaire	−0.940	0.391	0.120–1.271
Pain catastrophizing scale	−0.013	0.987	0.941–1.035

Hosmer Lemeshow test=0.988.

\* $p < 0.05$ , \*\* $p < 0.001$ .

the small sample size did not allow us to include in the logistic regression analysis all factors that might affect depressive symptoms. Furthermore, the odds ratio of psychological stress to depressive symptoms is low and should be interpreted with caution. Therefore, the sample size should be increased by including students from multiple universities. Third, most of the data on depressive symptoms, psychological stress, and other related factors were obtained from self-report questionnaires, which can be affected by subjective biases. Future research should include objective assessments to provide a more accurate evaluation of the relationship between psychological stress and depressive symptoms.

This study demonstrated that psychological stress was independently associated with depressive symptoms among Japanese university students. The results suggest that it is important to address psychological stress to improve and prevent depressive symptoms among university students.

### *Authors' contributions*

Ryota Ashizawa: Conceptualization & Data curation, Formal analysis, Investigation, Writing; Katsumi Hamaoka: Funding acquisition & Project administration, Investigation, Writing –review & editing; Hiroya Honda: Writing –review & editing; Yoshinobu Yoshimoto: Funding acquisition & Supervision.

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### *Conflicts of interest*

There is no conflict of interest to disclose.

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