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Article

Association between Menstruation-Related Symptoms and the Type of Stress in Japanese Female University Students: A Prospective Cohort Study from Admission to the Second Year

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Abstract: Menstruation-related symptoms in young women are associated with lifestyle factors such as stress. This study aimed to examine menstrual conditions, menstruation-related symptoms, and types of stress in Japanese female students from their first to second years of university and the association between menstruation-related symptoms and stress levels. This prospective longitudinal cohort study utilized a self-reported web survey with the Menstrual Distress Questionnaire (MDQ) at three timepoints (2, 8, and 14 months) following admission and continuing into the second year. Data from 33 out of 102 students, who were followed throughout the study period, were used for analysis. Results indicated a trend towards changes in menstrual regularity, with the lowest (48.5%) at timepoint 1 and the highest (72.7%) at timepoint 3, and significant changes in perceived bleeding amount. Stress related to study and academic performance was consistently highest, with significant differences across timepoints. Intra-menstrual MDQ scores were highest at timepoint 1, with significant variations in impaired concentration severity across timepoints. Significant correlations were found between the MDQ scores and stress related to health and personality at all timepoints, and to future prospects, friendships, study, and academic performance at different timepoints. In short, stress related to academic performance, along with a strong correlation between MDQ scores and specific stress types, such as health and personality, was observed across all timepoints. This implies the need to provide new students with health education regarding menstruation and stress management before specific timepoints.

Keywords: menstruation-related symptoms; fresh female university students; prospective cohort study; stress

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1. Introduction

Menstruation-related symptoms, such as pre-menstrual symptoms and menstrual pain, are highly prevalent among young women, with studies indicating that 51.3% of individuals experience premenstrual syndrome (PMS) [1] and 71.1% suffer from dysmenorrhea [2]. These manifestations not only disrupt daily functioning [3] but also exert an adverse impact on academic performance and absenteeism [2,4]. A meta-analysis [5] reveals an association between lifestyle factors, including smoking habits, sleep duration, and stress levels, and the prevalence and severity of menstruation-related symptoms.

The transition to university represents a major life shift for young women, involving changes in living arrangements and the adoption of new routines. Senior nursing students show lower psychological distress than that of junior students [6]. A study on stress among nursing students in Canada revealed that first-year students experienced stress mainly related to their academic courses [7]. Thus, such a transition can lead to increased stress in new students, potentially affecting menstruation and associated symptoms. It has been reported that over half of first-year university students in Turkey experience pre-menstrual

syndrome, especially those who smoke, drink alcohol, consume fatty foods excessively, and have a negative perception of their economic status [8]. In a longitudinal study conducted among newly enrolled female university students in Japan, lifestyle factors such as sleep patterns, dietary habits, and stress levels were implicated in the manifestation of severe premenstrual symptoms during the first 3 months after admission [9]. We also found that sleep duration was associated with menstruation-related symptoms during menstruation in fresh female Japanese university students at two timepoints, 3 and 9 months after admission, in a prospective cohort study [10]. The transition to university for new students is characterized by various stressors and health-related challenges.

A longitudinal study [11], spanning 10 weeks during the first quarter of university, highlighted elevated stress levels, specifically during examination periods. Further insights into the intricacies of the academic calendar were provided by a study conducted in Japan in which the enrollment period commenced in April, initiating the first semester, and the second semester began in October. Another study [12] reported that except during examination periods, fatigue among freshmen in nursing and health science courses was significantly higher in May than in April or June. Financial anxiety and mental health concerns are also prominent during this phase of university life. A study in China tracking first-year students over the initial 6 months of enrollment demonstrated a decline in perceived stress over time, measured at baseline, 2 months, and 6 months. Those following a low-stable stress trajectory exhibited higher levels of well-being and academic adjustment 8 months after enrollment [13].

While freshmen may face various types of stress during their first year in the university, only a few studies have investigated the change in the type of stress over time and how each stress level is associated with menstruation-related symptoms during the years. Therefore, this study aimed to examine the menstrual condition, menstruation-related symptoms, and type of stress experienced from their admission to second year of university, including at three timepoints (2, 8, and 14 months) after admission, and the association between menstruation-related symptoms and each stress level in Japanese female university students.

2. Results

As shown in Figure 1, 102 students were initially requested to participate in the study. However, by timepoint 3, only 38 students could be successfully tracked. After excluding five students who had previously used hormonal medication for gynecological diseases at any timepoint, the final dataset for analysis comprised thirty-three students.

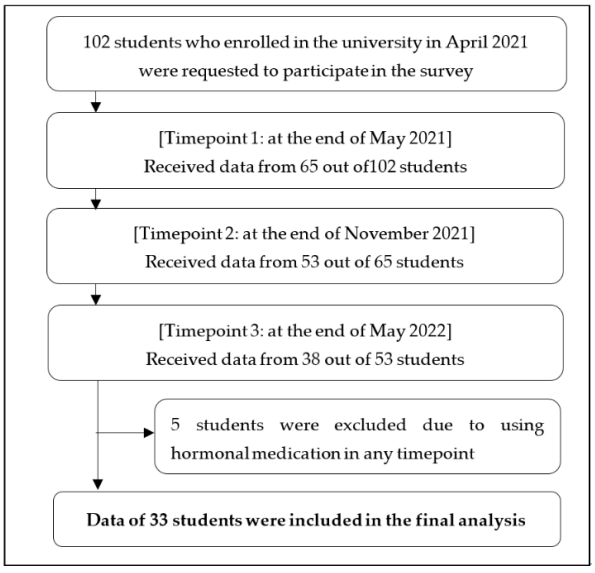

Figure 1. Flowchart of the sampling process. This flowchart outlines the data collection process used in the study. Each box represents a data collection stage, and the number of participants remains constant.

2.1. Characteristics of the Study Participants

The mean age (standard deviation: SD) at menarche was 12.0 (1.4) years. At timepoint 1, the mean age was 18.4 (0.5) years, and the mean height (SD) and weight (SD) were 156.8 (5.3) cm and 52.2 (6.7) kg, respectively (Table 1).

Table 1. Characteristics of the study participants at each timepoint (*N* = 33).

Characteristic	Timepoint 1		Timepoint 2		Timepoint 3	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	18.4	0.5	18.9	0.5	19.4	0.5
Height (cm)	156.8	5.3	157.2	5.2	157.2	5.4
Weight (kg)	52.2	6.7	52.0	6.6	52.9	7.4
BMI (kg/m^2)	21.2	2.4	21.0	2.4	21.4	2.8
	n	%	*n*	%	*n*	%
Engaging in part-time job	4	12.1	20	60.6	21	63.6
Engaging in extracurricular activities	2	6.1	23	69.7	22	66.7

BMI: body mass index.

2.2. Menstrual Cycle Status and Changes at Each Timepoint

Table 2 indicates the tendency for changes among the students regarding menstrual regularity (p = 0.059) across the four timepoints, including the pre-admission period. The proportion of students with regular menstruation was lowest (48.5%) at timepoint 1 and highest (72.7%) at timepoint 3. Additionally, a significant change was observed regarding the perceived amount of bleeding (p = 0.010). Specifically, a significant difference was observed between timepoints 1 (66.7%) and 3 (84.8%) (p = 0.010).

Table 2. Longitudinal changes in menstrual status and the occurrence of "normal" state at each timepoint (*N* = 33).

Menstrual Cycle Status	Category	Pre-Admission		After Admission						*p*-Value
				Timepoint 1		Timepoint 2		Timepoint 3		
		n	%	*n*	%	*n*	%	*n*	%	
Length	25–38 days	30	90.9	29	87.9	28	84.8	28	84.8	0.748
	Other	3	9.1	4	12.1	5	15.2	5	15.2	
Regularity	Regular	18	54.5	16	48.5	18	54.5	24	72.7	0.059
	Irregular	15	45.5	17	51.5	15	45.5	9	27.3	
Duration days	3–7 days	32	97.0	32	97.0	31	93.9	32	97.0	0.733
	Other	1	3.0	1	3.0	2	6.1	1	3.0	
Perceived amount of bleeding	Normal	23	69.7	22	66.7	25	75.8	28	84.8	0.010 (Timepoint 1 vs. 3: 0.010)
	Abnormal	10	30.3	11	33.3	8	24.2	5	15.2	

Statistical analysis was performed using Cochran's Q test, followed by Bonferroni tests.

2.3. Stress Levels across the Three Timepoints

Figure 2 illustrates that stress levels related to study and academic performance consistently ranked the highest across all timepoints, followed by stress related to future prospects and personality. A statistically significant difference in stress levels related to study and academic performance was observed across the three timepoints (p = 0.027). Furthermore, stress levels related to health and part-time jobs exhibited significant differences across the three timepoints (p = 0.036, p = 0.020, respectively). Notably, stress levels at timepoint 1 were highest for stress related to health and lowest for stress related to part-time jobs.

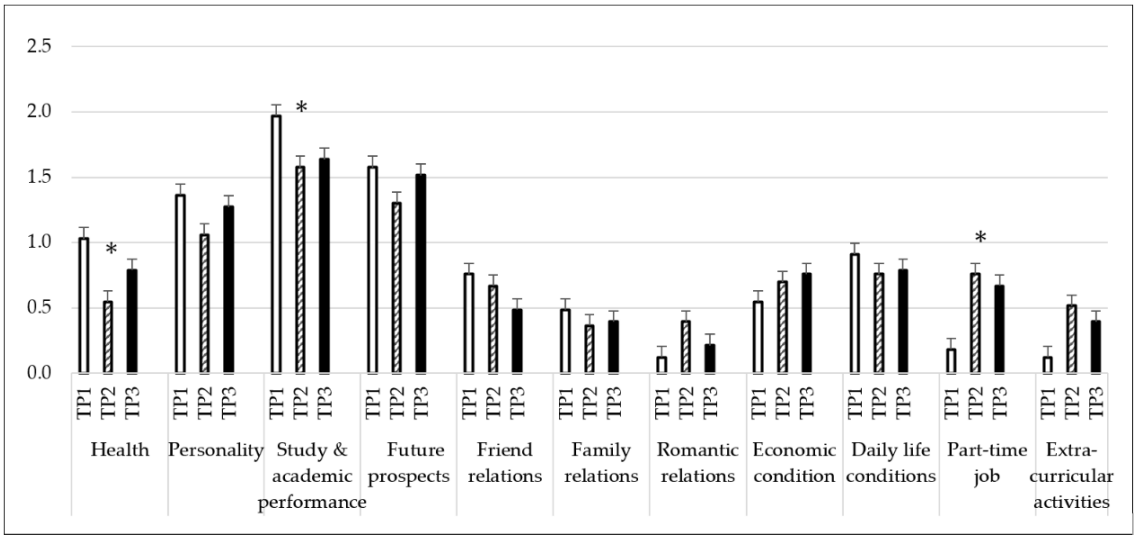

Figure 2. Mean and standard error of stress levels in time periods by stress type. TP1: timepoint 1 (white); TP2: timepoint 2 (striped); TP3: timepoint 3 (black). * $p < 0.05$, Friedman test; Bonferroni test for variables with significant differences.

2.4. Menstruation-Related Symptoms across the Three Timepoints

We used the Menstrual Distress Questionnaire (MDQ), a self-reported assessment tool designed to measure 46 menstruation-related symptoms categorized into eight subscales (see Section 4.4.3 for details). The prevalence of the six common menstruation-related symptoms in the pre-menstrual and intra-menstrual phases at each of the three timepoints is presented in Table 3. Regarding common pre-menstrual symptoms, mood swing, skin blemish or disorder, irritability, increased appetite, and craving for sweets appeared to be common at all timepoints. Moreover, the prevalence of increased appetite and craving for sweets was high at all timepoints. During the intra-menstrual phase, cramps were the most common symptom at all timepoints. Fatigue ranked second at timepoints 1 and 3 and third at timepoint 2.

Table 3. Prevalence of the six most common menstruation-related symptoms at the pre-menstrual and intra-menstrual phases across the three timepoints.

Period	Pre-Menstrual	%	Intra-Menstrual	%
Timepoint 1	Mood swings	72.7	Cramps	90.9
	Fatigue	69.7	Fatigue	81.8
	Skin blemish or disorder	69.7	Mood swings	78.8
	Irritability	63.6	Feeling sad or blue	78.8
	Increased appetite *	63.6	Irritability	75.8
	Craving for sweets *	63.6	Take naps, stay in bed	72.7
Timepoint 2	Craving for sweets *	69.7	Cramps	93.9
	Cramps	66.7	Backache	75.8
	Increased appetite *	66.7	Craving for sweets *	75.8
	Skin blemish or disorder	63.6	Fatigue	72.7
	Take naps, stay in bed	63.6	Take naps, stay in bed	72.7
	Mood swings	60.6	Skin blemish or disorder	69.7
	Irritability	60.6	Mood swings	69.7
Timepoint 3	Increased appetite *	81.8	Cramps	90.9
	Craving for sweets *	81.8	Fatigue	84.8
	Take naps, stay in bed	75.8	Backache	78.8
	Mood swings	66.7	Take naps, stay in bed	78.8
	Skin blemish or disorder	63.6	Craving for sweets *	72.7
	Irritability	60.6	Irritability	69.7

* Items are not included in the Menstrual Distress Questionnaire (MDQ).

Figure 3 shows a comparison of the MDQ total and subscale scores across three timepoints during the pre-menstrual and intra-menstrual phases. The MDQ total score at timepoint 1 was the highest for both phases; however, no significant differences were observed between timepoints. A significant difference was identified in the severity of impaired concentration during the intra-menstrual phase across the three timepoints ($p = 0.041$). Furthermore, no statistically significant difference in food-related symptoms was observed between the three timepoints.

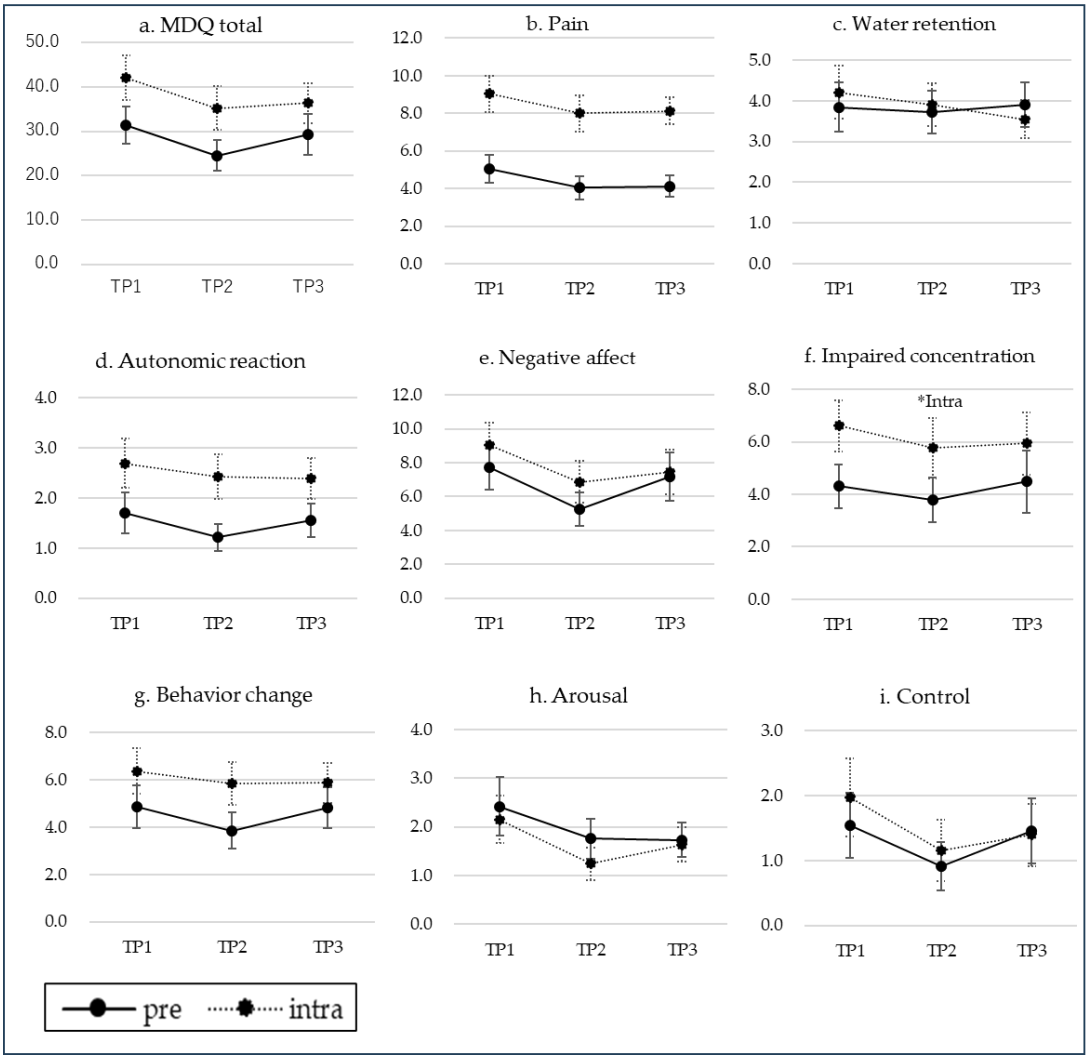

Figure 3. Change in the Menstrual Distress Questionnaire (MDQ) total scores (**a**) and subscale scores (**b**–**i**) across the three timepoints in the pre-menstrual and intra-menstrual phases. The subscales include pain (**b**), water retention (**c**), autonomic reaction (**d**), negative affect (**e**), impaired concentration (**f**), behavioral change (**g**), arousal (**h**), and control (**i**). The data points in the lines represent the mean MDQ scores, with error bars indicating standard errors. Solid line represents the pre-menstrual phase. Dotted line represents the intra-menstrual phase. TP1: timepoint 1; TP2: timepoint 2; TP3: timepoint 3. * $p < 0.05$; Friedman test.

2.5. Correlation between the MDQ Total Score and Each Stress Level in Pre-Menstrual and Intra-Menstrual Phases at Each Timepoint

As shown in Table 4, the MDQ total scores during the pre-menstrual and intra-menstrual phases exhibited significant correlations with stress levels related to health and personality at all timepoints. At timepoint 1, the MDQ total score correlated with stress levels related to future prospects. In contrast, at timepoints 2 and 3, stress levels related to friendships demonstrated correlation with the MDQ total score in both pre-menstrual

and intra-menstrual phases. Additionally, stress levels related to study and academic performance, as well as to future prospects, demonstrated correlation with the MDQ total score in the pre-menstrual phase at timepoints 2 and 3. Moreover, stress levels related to daily life conditions demonstrated correlation with the MDQ total score only in the pre-menstrual phase at timepoint 2.

Table 4. Correlation between the MDQ total score and each stress level in the pre-menstrual and intra-menstrual phases at each timepoint.

Stress	MDQ Total Score					
	Timepoint 1		Timepoint 2		Timepoint 3	
	Pre-Menstrual	Intra-Menstrual	Pre-Menstrual	Intra-Menstrual	Pre-Menstrual	Intra-Menstrual
Health	0.445 **	0.562 **	0.486 **	0.433 *	0.646 **	0.533 **
Personality	0.414 *	0.407 *	0.691 **	0.414 *	0.457 **	0.448 **
Study and academic performance	0.204	0.298	0.372 *	0.100	0.366 *	0.170
Future prospects	0.365 *	0.464 **	0.400 *	0.192	0.361 *	0.216
Friendship	0.135	0.132	0.431 *	0.416 *	0.422 *	0.386 *
Family relations	0.182	0.089	0.273	−0.046	0.090	0.146
Romantic relations	0.196	0.153	0.163	0.077	0.186	0.235
Economic condition	0.281	0.226	0.079	0.104	0.099	−0.089
Daily life conditions	0.061	0.077	0.380 *	0.197	0.324	0.203
Part-time job	0.093	0.076	−0.047	−0.220	0.030	0.162
Extracurricular activities	0.244	0.205	0.073	0.150	0.154	0.037

Spearman's rank correlation coefficient. ** $p < 0.01$, * $p < 0.05$.

3. Discussion

To our knowledge, this is the first study to investigate menstruation, menstruation-related symptoms, and stress levels in university freshmen across three timepoints after their admission into the second year. We observed a tendency for changes in students' menstrual regularity to increase, with the lowest proportion of students with regular menstruation at timepoint 1 (48.5%) and the highest proportion at timepoint 3 (72.7%). Additionally, a significant change was identified in the perceived amount of bleeding between timepoints 1 (66.7%) and 3 (84.8%). Our previous study revealed no significant change across the three timepoints, before admission and 3 months and 9 months after admission, in terms of menstrual cycle status, including menstruation regularity and perceived amount of bleeding [10]. This suggests that menstrual regularity and the perceived amount of bleeding may stabilize by the time they become second-year students, possibly as a natural consequence of maturing into adulthood. However, further investigation is warranted to explore whether adjustment to university life influences this stabilization process. Additionally, we observed that although the MDQ total score did not significantly change across the three timepoints, the scores were highest at timepoint 1, followed by those at timepoints 3 and 2, during the pre-menstrual and intra-menstrual phases. A significant difference in the severity of impaired concentration was observed only during the intra-menstrual phase across the three timepoints, and it was highest at timepoint 1. Previous research supports these findings, suggesting that impaired concentration tends to be higher in the months immediately following admission to university than in later months [9,10]. A non-significant relationship was observed between academic year (second to sixth year) and the type of menstrual abnormalities in medical students [14]; however, this survey did not include the first-year students. Therefore, it is crucial for educators to recognize that new female students may experience difficulties with concentration, particularly during the intra-menstrual phase, in the initial period to 2–3 months after entering university.

We found how various types of stress levels were changed at three timepoints. Our findings consistently revealed that stress levels related to academic performance and study

responsibilities consistently ranked highest across all timepoints, followed by stress concerning future prospects and personal identity. These results align with those of previous studies, which identified academic pressure as the primary stressor for Japanese first-year female students, followed by concerns about friendships and engaging in part-time jobs [15]. The stress levels related to health, study and academic performance, and part-time jobs differed among the three timepoints. Timepoint 1 exhibited the highest stress related to health, studies and academic performance, and the lowest stress related to part-time jobs. At timepoint 1, the students enrolled in 2021 amidst the COVID-19 pandemic were requested by the university administration to be more careful about their health and prevention behavior, likely contributing to the heightened stress levels related to health concerns. Regarding part-time jobs, the number of students engaging in part-time jobs increased by five times from timepoint 1 to timepoint 2, potentially leading to a corresponding increase in stress levels. Although the number of students engaging in extracurricular activities was also increasing, by ten times from timepoint to timepoint 2, there was not a significant association with stress during these timepoints.

In addition, this study is the first to investigate the association between various types of stress levels and menstruation-related symptoms among university students during the transition from admission to the second year. A meta-analysis demonstrated a significant association between stress and the prevalence of primary dysmenorrhea [5]. Additionally, it has been reported that stress is associated with menstruation-related symptoms among university students in Japan, with self-reported stress demonstrating a strong correlation with pre-menstrual symptoms [16]. Similarly, a strong positive association between psychological stress and dysmenorrhea and pre-menstrual symptoms was observed in a study conducted in Saudi Arabia [17]. The severity of dysmenorrhea was found to be associated with stress levels in Pakistan [18], whereas stress and PMS levels demonstrated a positive correlation in South Korea [19]. In this study, we found that the levels of specific types of stress demonstrated a correlation with the MDQ total scores at each timepoint. A consistent correlation was observed between the MDQ total scores in the pre-menstrual and intra-menstrual phases and stress levels related to health and personality across all three timepoints. In addition, at timepoint 1, the stress related to future prospects was only associated with the MDQ total score; this stress also demonstrated a correlation with the MDQ total score in the pre-menstrual phase at timepoints 2 and 3. Stress related to study and academic performance demonstrated a correlation with the MDQ total score in the pre-menstrual phase at timepoints 2 and 3. However, we did not find this association during the intra-menstrual phase. A study conducted in Palestine reported that students having stress related to academic performance and life had 1.53 times higher odds of having moderate to severe dysmenorrhea compared with students who did not have stress related to academic performance [20]; however, we did not find such an association in the present study. At timepoints 2 and 3, stress related to friendship was a key factor that correlated with the MDQ scores in the pre-menstrual and intra-menstrual phases. This implies the need for health education regarding stress management before a specific timepoint for freshmen. A longitudinal study including new university students reported elevated stress during examination periods [11], and nursing students experienced higher stress during the 2nd and 4th years than during other years [21]. In addition, medical students showed a significant frequency of menstrual abnormalities such as dysmenorrhea, cycle lengthening, and heavy bleeding during examination periods [14]. Therefore, further studies are warranted to include examination periods and long-term follow-up to determine if the type of stress level and menstruation-related symptoms would change over time.

The study has a few limitations, including a small sample size, a high dropout rate, and the fact that all students were from a single department within one university. These factors may restrict the generalizability of the findings. Furthermore, the selection of only three timepoints for data collection excluded potentially stressful periods such as examination periods. Additionally, the reliance on subjective perceptions to assess menstrual bleeding and the influence of the COVID-19 pandemic, which began in late 2019, are potential

biases. It is important to acknowledge the limitations of online self-reported data, which may need further investigation using methods such as in-person interviews and medical examinations to ensure accuracy and depth of analysis.

4. Materials and Methods

4.1. Study Design

We conducted a prospective longitudinal cohort study using a self-reported web survey. Data were collected at three timepoints, including timepoint 1 (from 27 May 2021 to 6 June 2021; 2 months after admission), timepoint 2 (from 29 November 2021 to 13 December 2021; 8 months after admission), and timepoint 3 (from 30 May 2022 to 11 June 2022; 14 months after admission).

4.2. Participants

The participants consisted of 102 female university students, representing the total number of students enrolled in an undergraduate course at a Japanese university in April 2021. Regarding the inclusion criteria, participants must provide informed consent, must not be pregnant or within a year after giving birth, nor presently using hormones for gynecological treatment and contraception, which could affect their menstrual status and menstruation-related symptoms, and must be available for the entire study duration, from the first to the last data collection timepoint.

4.3. Procedure

During remote classes, researchers presented research outlines to students using explanatory documents and requested their participation in the survey. Ethical considerations, such as voluntary participation, anonymity, and freedom to discontinue participation without any impact on grades, were thoroughly explained. Data collection was facilitated through SurveyMonkey®, with the web survey's URL and QR code provided in the documents. Upon accessing the survey, students were prompted on the first page to confirm their consent by checking a consent checkbox before proceeding further. In the initial survey, students were asked to provide their email addresses for future survey invitations. For timepoints 2 and 3, survey invitations containing the URL and QR code were sent via e-mail to students who had completed the previous survey. Each student was assigned an identification number to facilitate tracking of individual changes over time. This study received approval from the Ethics Committee of Tokushima University Hospital (approval number: 3932-1).

4.4. Measurements

4.4.1. Characteristics

This category encompassed information such as age, body weight, body height, and age at menarche.

4.4.2. Menstruation

This category comprised information regarding the students' current menstrual conditions, including menstrual cycle length, regularity, duration, perceived amount of menstrual bleeding, and current visits for gynecological diseases or for receiving hormone therapy. At timepoint 1, the students were asked to provide retrospective data on their preadmission menstrual conditions.

4.4.3. Menstruation-Related Symptoms

We used the MDQ [22,23], a self-reported assessment tool designed to measure menstruation-related symptoms, encompassing 46 symptoms. These forty-six symptom items are categorized into eight subscales as follows: pain (six items), water retention (four items), autonomic reactions (four items), negative affect (eight items), impaired concentration (eight items), behavioral change (five items), arousal (five items), and control

(six items). In addition, we incorporated three eating behavior items, specifically addressing increased appetite, cravings for sweets, and cravings for snacks. These eating behavior items were identified as common menstruation-related symptoms based on our previous studies [24,25]. In total, 49 symptoms were assessed during two periods: before and during menstruation. The students used a five-point scale, with scores ranging from 0 (no feeling) to 4 (severe), to indicate the severity of each symptom.

4.4.4. Stress Level

We assessed the participants' stress levels based on 11 stressors, selected from previous studies [26,27], including physical health (excluding menstruation), personality, family relations, friendship, romantic relationships, study and academic performance, future prospects, economic status, and daily life responsibilities, such as increased housework, engaging in a part-time job, and club activities. Participants rated the intensity of stress for each item on a five-point scale, ranging from 0 (no feeling) to 4 (severe).

4.5. Statistical Analysis

Descriptive statistics were performed for each variable, presented as numbers with percentages or means with standard deviations. Cochran's Q test was used to assess the proportion of students with normal or abnormal menstrual conditions. Changes in the MDQ total scores and eight subscale scores, as well as in stress levels, were analyzed across the three timepoints using the Friedman test, followed by the Bonferroni test for post hoc analysis. The correlation between the MDQ total scores and stress levels at each timepoint was evaluated using the Spearman rank correlation test. Data analysis was conducted using SPSS Statistics version 28.0 for Windows (IBM Corp., Armonk, NY, USA), with a two-sided significance level set at 5%.

5. Conclusions

In conclusion, we found that stress levels related to study and academic performance consistently ranked highest across all timepoints; a consistent correlation was observed between the MDQ total scores in pre-menstrual and intra-menstrual phases and stress levels related to the level of specific types of stress, such as that for health and personality, across all three timepoints. This implies the need to provide health education regarding stress management before specific timepoints for new students. Such interventions could aid in mitigating stress-related challenges faced by freshmen transitioning to university life.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Tokushima University Hospital (approval number: 3932-1 on 30 May 2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are not publicly available because of privacy restrictions. Further inquiries can be directed to the corresponding author.

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Conflicts of Interest: The authors declare no conflicts of interest.

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