

The Impact of Online Learning and Health Behavior on Mental Health among Thai Dental Students during the COVID-19 Era

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ABSTRACT

Aims: This study aimed to investigate the impact of online learning on the mental health and health behaviors of Thai dental students during the coronavirus disease 2019 (COVID-19) pandemic. **Materials and Methods:** A cross-sectional analytical study was conducted among Thai dental students from first to sixth year who had been engaged in online learning during the COVID-19 period. A total of 440 students participated. Data were collected from January to March 2023 using an online questionnaire comprising 36 items addressing demographic information, online learning experiences, and health behaviors, including exercise and sleep. Psychological health was assessed using the Depression, Anxiety, and Stress Scale-21 (DASS-21). Data analysis included descriptive statistics, chi-square tests, binary logistic regression, Pearson's correlation, and simple linear regression. **Results:** The study found high rates of mental health issues among the participants, with 58.2% experiencing depression, 57.3% experiencing anxiety, and 41.1% reporting stress. Personal factors influencing mental health included university type and household situation. Key factors associated with depression were the number of hours spent on assignments and the quality of the online learning environment ($\beta = 1.096, 1.193$). For anxiety, factors such as frequency of exercise, sleep quality, time spent on assignments, and familiarity with assignment submission platforms were significant ($\beta = -0.773, -0.666, 0.801, 1.002$). Stress was significantly correlated with the frequency of exercise, sleep quality, and assignment workload ($\beta = -1.072, -0.497, 1.210$). **Conclusions:** The findings highlight a significant association between online learning-related factors, such as the number of hours spent on assignments, and the mental health outcomes of dental students. Health behaviors, particularly exercise and sleep quality, were also linked to mental health status. These results suggest that interventions aimed at reducing assignment-related stress, improving sleep hygiene, and promoting physical activity may be crucial in mitigating mental health problems among dental students. Clinically, addressing these factors could enhance both psychological well-being and academic performance, ultimately contributing to more effective learning environments for dental professionals.

KEYWORDS: Anxiety, COVID-19, DASS-21, dental student, depression, mental health, online learning, stress

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INTRODUCTION

Most dental students often experience stress during their studies due to lectures and practical work. The heavy workload causes insufficient rest time and pressure, which contributes to mental health issues. A previous study on mental health in dental students at Srinakharinwirot University using the GHQ12 found that dental students have a high chance of developing mental health problems at a rate as high as 37.3%.^[1] This is consistent with the findings of a study by Chulalongkorn University that 45.2% of dental students have anxiety and 21.7% have depression.^[2]

The coronavirus disease epidemic of 2019 (COVID-19) started in December 2019 and spread quickly to numerous nations worldwide. On March, 2020, the World Health Organization declared COVID-19 to be a pandemic.^[3] As a counter-measure, nationwide lockdown policies were imposed on individuals to prevent the spread, such as physical distancing, wearing a mask, and the closure of places and educational institutions.^[4] These policies have affected education in dental school by changing from traditional education to online learning.^[5] Several international studies evaluated the psychological effects of COVID-19 on dental students as dental students faced more mental health problems owing to online learning.^[6-9] In Thailand, several studies on other sample groups such as doctors and nurse students have been conducted. Some studies in Thai dental students used a difference psychological health assessment tool which assessed only stress.^[10,11] Currently, there is very limited information on the effect of online learning and health behavior on mental health among Thai dental students during the pandemic. Therefore, this research aims to investigate the effects of online learning on mental health and health behavior factors of Thai dental students during the time of the COVID-19 outbreak and to assess psychological health using the Depression, Anxiety, and Stress Scale-21 Item questionnaires (DASS-21).

MATERIALS AND METHODS

A cross-sectional study was conducted from January to March 2023 among dental students in the first to sixth year of the School of Dentistry in Thailand, who had online learning during the pandemic. To assess health behavior factors, the study utilized an adaptive Health Behavior Questionnaire, which was developed and validated for this research. The questions were as follows: exercise frequency and duration and sleep patterns.^[12,13]

Patients declaration of consent

All the parents of the participants obtained the consent forms and participant information sheet.

Data collection

The data were collected using 36-item online questionnaires via the Google Form application from January to March 2023. The university in Thailand includes Srinakharinwirot University, Naresuan university, Khon Kaen University, Rangsit University, and Western University. The respondents were notified that their participation in the questionnaire survey was voluntary and anonymous, and their informed consent was obtained. The respondents who did not study online and did not agree to answer the questionnaires will be excluded. The questionnaires consisted of four sections: demographic data, online learning factor, health behavior, and DASS-21. DASS-21 is a self-report scale that assesses three domains of the emotional states such as depression, anxiety, and stress. Each of the three emotional groups contained seven items, with each item measured on a 4-point scale. The rating scales were scored as follows: 0 = indicates that it did not apply to me at all, 1 = indicates that it applied to me sometime or occasionally, 2 = indicates that it applied to me more frequently, and 3 = indicates that it applied to me most of frequently. The scores of the pertinent questions were added up, and the results were interpreted as normal, mild, moderate, severe, and extremely severe for depression, anxiety, and stress.^[14]

Sampling procedure

Multistage cluster random sampling was used. In the first stage, Thai dental schools were divided into two groups: public schools and private schools. In the second stage, a representative sample of dental schools was chosen through simple random sampling. Out of 12 public and six private dental schools, three public and two private schools were selected. These five schools were then classified by location, with three located in Bangkok and two in other provinces. Then, the participants from 1st to 6th year were chosen using stratified random sampling. The sample size was determined using W.G. Cochran's sample size formula and the fraction of the population that displays the attribute (P) is 0.349, the error probability at 0.05, and the analysis power of 0.95. After the 20% dropout compensation rate, a total of 440 dental students were recruited in this study.^[6]

Statistical analysis

Statistical analysis was performed using SPSS version 28. Descriptive analysis was performed in demographic data, online learning factors, health behavior factors, and DASS-21 test. The scores of reliability test of online learning factors, health behavior factor questionnaires, and DASS-21 with Cronbach α coefficient and discrimination power

are more than 0.7, except that the workload is 0.663. A chi-squared test and binary logistic regression were employed to evaluate the ratios among the demographic information. (gender, dental class, type of university, location of university, and household) and mental health (depression, anxiety, and stress). Pearson's correlation analysis and simple linear regression were used between psychological scales and

online learning factors and health behavior factors. A value of $P < 0.05$ was considered statistically significant for each test. To evaluate the reliability of the questionnaire items, Cronbach α was calculated.

RESULTS

A total of 440 undergraduate dental students from five different dental colleges (three public schools and two private schools) in Thailand completed the questionnaires. The majority of the participants were female ($n = 303$, 68.9%). Fourth-year dental students formed the largest group ($n = 109$, 24.8%). The general demographic of the dental students is shown in Table 1. According to DASS-21 scoring, the overall prevalence of abnormal levels of depression, anxiety, and stress was 58.2%, 57.3%, and 41.4%, respectively. The distribution of participants according to severity based on DASS scores is depicted in Table 2.

The prevalence of stress and depression was higher in women, clinical dental students, those who were studying in private university, those who were from the university in Bangkok, and those who were living alone. The higher scores of anxieties occurred in conjunction with depression and stress, except for preclinical dental students who tend to have higher anxiety scores than clinical dental students [Table 3].

Depression was significantly associated with gender, type of university, and household. The female dental students, students who were studying in private universities, and those who living alone were 1.981, 1.770, and 2.347 times more likely to have depression than the male dental students (95% CI = 1.291–3.042), students who studying in public universities (95%CI = 1.062–2.883) and those living with accompanied (95% CI = 1.150–3.649), respectively [Table 4].

Table 1: Frequency and percentage of personal factors of the sample ($n = 440$)

	Demographic	N (%)
Gender	Male	137 (31.1)
	Female	303 (68.9)
Dental year	First year	75 (17)
	Second year	66 (15)
	Third year	56 (12.7)
	Fourth year	109 (24.8)
	Fifth year	77 (17.5)
	Sixth year	57 (13)
Dental class	Pre-clinic	197 (44.8)
	Clinic	243 (55.2)
Type of university	Public	243 (55.2)
	Private	197 (44.8)
Location of university	Bangkok	306 (69.5)
	Other province	134 (30.5)
Household	Not alone	281 (63.9)
	Alone	159 (36.1)

Table 2: The sample's level of stress, anxiety, and depression ($n = 440$)

Level	Depression N (%)	Anxiety N (%)	Stress N (%)
Normal	184 (41.8)	188 (42.7)	258 (58.6)
Mild	69 (15.7)	79 (18)	62 (14.1)
Moderate	113 (25.7)	67 (15.2)	66 (15)
Severe	50 (11.4)	40 (9.1)	43 (9.8)
Extremely severe	24 (5.5)	66 (15)	11 (2.5)

Table 3: Frequency, percentage, and average of depression, anxiety, and stress scores of the personal factors of the sample ($n = 440$)

Variables		Average depression score (mean \pm SD)	Average anxiety score (mean \pm SD)	Average stress score (mean \pm SD)	N (%)
Gender	Male	5.54 \pm 4.31	4.33 \pm 3.78	6.04 \pm 4.14	137 (31.1)
	Female	6.45 \pm 4.25	5.31 \pm 4.15	7.35 \pm 4.35	303 (68.9)
Dental class	Pre-clinic	5.91 \pm 4.65	5.26 \pm 4.58	6.95 \pm 4.73	197 (44.8)
	Clinic	6.38 \pm 3.96	4.79 \pm 3.57	12.52 \pm 3.98	243 (55.2)
Type of university	Public	5.26 \pm 3.95	3.97 \pm 3.53	5.97 \pm 3.94	243 (55.2)
	Private	7.29 \pm 4.42	6.28 \pm 4.31	8.18 \pm 4.46	197 (44.8)
Location of university	Bangkok	6.58 \pm 4.35	5.33 \pm 4.16	7.23 \pm 4.32	306 (69.5)
	Other province	5.24 \pm 3.99	4.27 \pm 3.70	6.31 \pm 4.27	134 (30.5)
Household	Not alone	5.49 \pm 4.13	4.30 \pm 3.81	6.36 \pm 4.37	281 (63.9)
	Alone	7.36 \pm 4.30	6.19 \pm 4.21	7.97 \pm 4.06	159 (36.1)

Table 4: Logistic regression relationship between mental health and personal factors of the samples ($n = 440$)

Variables		Depression		Anxiety		Stress	
		<i>P</i> value	Adjusted OR (95% CI)	<i>P</i> value	Adjusted OR (95% CI)	<i>P</i> value	Adjusted OR (95% CI)
Gender	Male	0.002	1	0.012	1	0.089	1
	Female		1.981 (1.291, 3.042)		1.745 (1.133, 2.688)		1.471 (0.943, 2.295)
Dental class	Pre-clinic	0.061	1	0.549	1	0.977	1
	Clinic		1.470 (0.983, 2.198)		1.132 (0.755, 1.698)		0.994 (0.662, 1.493)
Type of university	Public	0.028	1	<0.001	1	<0.001	1
	Private		1.770 (1.062, 2.883)		2.784 (1.686, 4.598)		3.244 (1.918, 5.487)
Location of university	Bangkok	0.212	1	0.610	1	0.878	1
	Other province		0.705 (0.407, 1.221)		0.868 (0.503, 1.497)		1.047 (0.579, 1.894)
Household	Not alone	<0.001	1	<0.001	1	<0.001	1
	Alone		2.347 (1.510, 3.649)		2.244 (1.443, 3.489)		2.296 (1.495, 3.526)

Table 5: Simple linear regression of mental health with online learning factors and health behavioral factors of the sample ($n = 440$)

Depression		Correlation coefficient (β)		SE	<i>P</i> -value
Online learning factors	Hours spent on assignments (AssT)	1.096**		0.210	<0.001
	Suitability of online learning environment (OBP)	1.193**		0.191	<0.001
$y = 1.096\text{AssT} + 1.193\text{OBP} + 0.748$, $R^2 = 0.137$					
Anxiety		Correlation coefficient (β)		SE	<i>P</i> value
Online learning factors	Hours spent on assignments (AssT)	0.801**		0.217	<0.001
	Ability to use submission platform (OBPF)	1.002**		0.204	<0.001
Health behavior factors	Number of exercise time (Ex)	-0.773**		0.182	<0.001
	Number of good quality sleep days (SLW)	-0.666**		0.169	<0.001
$y = 0.801\text{AssT} + 1.002\text{OBPF} - 0.773\text{Ex} - 0.666\text{SLW} + 3.475$, $R^2 = 0.266$					
Stress		Correlation coefficient (β)		SE	<i>P</i> value
Online learning factors	Hours spent on assignments (AssT)	1.210**		0.215	<0.001
Health behavior factors	Number of exercise time (Ex)	-1.072**		0.201	<0.001
	Number of good quality sleep days (SLW)	-0.497*		0.182	0.007
$y = 1.210\text{AssT} - 1.072\text{Ex} - 0.497\text{SLW} + 7.659$, $R^2 = 0.181$					

Simple linear regression analysis revealed ($R^2 = 0.137$, $P < 0.001$). Two factors of online learning factors were significantly positively correlated with depression: hours spent on assignments ($\beta = 1.096$) and the suitability of online learning environment ($\beta = 1.193$) [Table 5].

Similarly, anxiety was significantly associated with gender, type of university, and household. The female dental students, students who studying in private universities, and those living alone had 1.745, 2.784, and 2.244 times the probability of developing anxiety than male dental students (95% CI = 1.133–2.688), students who studying in public universities (95%CI=1.686–4.598), and those who living with accompanied (95% CI = 1.433–3.489) respectively [Table 4].

Simple linear regression analysis revealed ($R^2 = 0.266$, $P < 0.001$). Two factors of online learning factors significantly positively correlated with anxiety: hours spent on assignments ($\beta = 0.801$) and the suitability of online learning environment. ($\beta = 1.002$) [Table 5],

as well as two factors of health behavior were also significantly negatively correlated with anxiety: number of exercise times ($\beta = -0.733$), and number of good-quality sleep days ($\beta = -0.666$) [Table 5].

Finally, stress was significantly associated with type of university and household. The students studying in private universities and those living alone were 3.003 and 2.179 times more likely to have stress compared to students who studying in public universities (95% CI = 1.918–5.487) and those who living with accompanied (95% CI = 1.495–3.526), respectively [Table 4].

Simple linear regression analysis revealed ($R^2 = 0.181$, $P < 0.001$). Only one factor of online learning factors was significantly positively correlated with stress hours spent on assignments ($\beta = 1.210$), and two factors of health behavior were also significantly negatively correlated with anxiety: number of exercise times ($\beta = -0.072$) and number of good-quality sleep days ($\beta = -0.497$) [Table 5].

Table 6: Summary table of the reviewed papers

Authors	Sample	Sample size	Sample age	Measures used	Summary of findings
Keskin ^[8]	Turkey fifth year dental students	259	20–25	DASS-21	All depression, anxiety, and stress characteristics had higher mean values in females than in males ($P < 0.05$).
Chonngkonsatit ^[15]	Dental students in private university	578	First to sixth year	Suanprung stress test-20 (SPST-20)	Private university has a significant number of students who have not achieved educational completion and need to maintain enrollment status for an extended period. Students in this group often experience much higher levels of stress compared to students in other groups.
Erturk and Delikan ^[7]	Dentistry students	919	First to fifth year	PSS-10	Students attending public institutions reported considerably higher levels of stress than those attending private universities ($P = 0.034$). Private institutions with stronger financial status have greater access to the Internet and better gadgets, making it easier for them to participate in distance learning programs. They were therefore less stressed than students at public colleges who were ill-prepared for the process of distance learning.
Hakami <i>et al.</i> ^[6]	Saudi Arabia dental student	697	First to fifth year	DASS-21	All depression, anxiety, and stress characteristics had higher mean values in females than in males ($P < 0.05$). Students who were single had a higher likelihood of experiencing high levels of tension, anxiety, and despair; however, during the lockdown, these symptoms significantly decreased over time.
Hakami <i>et al.</i> ^[9]	Saudi Arabia dental student	1287	First to fifth year	DASS-21	Severe depression, anxiety, and stress were noted in 60.64%, 37.02%, and 34.92% of the students, respectively.
Ustun ^[16]	Citizen of Turkish republic	1115	18–65 years	Online questionnaires	According to this study, people who experienced isolation during the quarantine were at intermediate risk for developing depression and exhibited moderate signs of the depression.
Sundarasan <i>et al.</i> ^[17]	University students in Malaysia	983		Self-rating anxiety scale (SAS) self-rating anxiety questionnaire.	Anxiety levels were substantially correlated with staying alone (OR = 2.208, 95% CI = 1.127, 4.325, $P = 0.021$)..
Kouzma ^[18]	Senior High School Students	369	16–18 years	Self-reported Stress scale	There are notable correlations between senior high school students' self-reported stress levels, the number of hours they spend on homework, and mood disturbance.
Yeo <i>et al.</i> ^[19]	Student in Singapore	1225	13–19 years old	Kutcher Adolescent Depression Scale (KADS)	Teenagers who worked on their schoolwork for extended periods of time had higher depression scores, and those who worked on it for more than 5 h a day showed more signs of anxiety.
Amir <i>et al.</i> ^[20]	Dental Students Of The Faculty Of Dentistry Universitas Indonesia	301	Undergraduate first-, second-, and third-year dental students	The Online questionnaire	Thirty-five percent of the students reported feeling stressed out due to unstable internet connections and other issues, such as students not being ready for the new learning style.
Prasertsong <i>et al.</i> ^[21]	Nursing students in Thailand	152	Undergraduate nursing students.	-Connor-Davidson Resilience Scale [CD-RISC (-the Brief COPE inventory)	Factors that were significantly related to stress of online learning, were the academic environment and the communication breakdown classified as latency in data transmission, stability of the waves or the internet of the network

Table 6. Continued

Authors	Sample	Sample size	Sample age	Measures used	Summary of findings
Fawaz and Samaha ^[22]	Lebanese University Students	520	Undergraduate university students	DASS-21	Technological difficulties such as challenging to hand in requirements contributing to more stressors.
Kintarak and Visalseth ^[12]	Songkla University Dental Students.	289	Dental students (from year 1 to 6)	Thai GHQ-12	Dental students who lack exercise were 2.2 times more likely to suffer mental health problems than dental students who exercise.
Wuthrich <i>et al.</i> ^[23]	-	-	Final 2 years of secondary school	Systemic review	Adolescents commonly reported unrefreshing sleep associated with high levels of depressed and anxiety
Richards <i>et al.</i> ^[24]	-	-	-	Systemic review	The prevalent psychological models of insomnia provide a good basis for understanding the reciprocal mechanisms underlying the relationship between sleep disturbance, anxiety, and disorder. These models highlight the mutually reinforcing effects of fear and anxiety-based cognitive hyperarousal in the sleep environment and maladaptive behavioral coping.

After concluding all factors, it could be observed that mental health problems are associated with type of university, household, and the hours spent on assignments. This research provides the novel finding that hours spent on assignments are associated with depression, anxiety, and stress.

DISCUSSION

From our study, we inferred that females were more prone to depression and anxiety, which is similar to the findings of a study conducted in Turkey, implying that compared to men, women had greater mean values for all forms of stress, anxiety, and depression.^[8] Our results demonstrated that students who attended private schools had more mental health problems than students who attended public schools. A similar conclusion was reached by a study conducted in Thailand which said that students in private schools have higher stress levels. The researchers explained that private schools have more number of students who are not graduates, which led them to have more mental health problems.^[15] However, contradictory to a study conducted in Turkey, it was found that private universities' students have financial readiness, which made them have fewer mental health problems than those who attended public universities.^[7] Additionally, we discovered that students living alone had greater rates of mental health issues, which aligns with the findings of previous research conducted in Turkey, Malaysia, and Saudi Arabia.^[6,9,16,17] This could be attributed to the lack of social support, as students living alone did not have members to share their concerns with

or receive advice from, which is essential in reducing chronic stress and anxiety that affect mental health.^[6,9]

Regarding online learning factors, the number of hours spent on assignments was associated with mental health problems, similar to a study in Australia, which proposed said that the number of hours spent on homework significantly has a positive relationship with stress level,^[18] and also a similar pattern of results was obtained in Singapore, which found that the number of hours spent on homework significantly has a positive relationship with depression and anxiety level.^[19] With changes in the learning system from face-to-face to online learning, assignment instructions also change from two-way to one-way communication, which may lead students to spend more time to understand the instructions and to achieve the work. As mentioned previously, this may increase mental health problems.

For an online learning environment, the poor surrounding environment can increase depression levels. This finding is similar to that of a study in Indonesia that found that unstable internet connection contributed to stress.^[20] From our research, it was found that students who had lower technology skills had higher anxiety levels, which has the same result as that of a study conducted in Thailand, which said that technological difficulties such as challenging to hand in requirements contribute to more stressors.^[21] We also found that the ability to use assignment submission platforms has a positive relationship with anxiety level, which agreed with the findings of a previous research study in Lebanon, which found that students who lack of use assignment submission platforms skill were more prone to anxiety.^[22]

Regarding health behavior factors, this study focused solely on exercise and sleep because these behaviors are closely related to the daily routines of dental students. It was found that those exercising less were more prone to increased anxiety and stress levels. Similarly, a previous study in Thailand found that dental students who did not engage in regular exercise were 2.2 times more likely to experience mental health issues compared to those who exercised.^[12] These findings were in line with the study's hypothesis that the number of exercise times was associated with mental health.

Lastly, the less good-quality sleep, the more anxiety and stress levels. Similarly, a study in Australia and India reported that unrefreshing sleep is associated with high levels of depression and anxiety.^[23,24] These findings were consistent with the study's hypothesis that good-quality sleep is associated with mental health. The summary of findings for all research discussed is shown in Table 6.

Implications

- (1) Private universities should prepare for online learning and suitable activity to promote mental health, as well as monitor and assess dental students' mental health and wellbeing.
- (2) Universities with student dormitories should offer at least one roommate to each student, allowing them to share concerns and receive advice, for reducing chronic stress and anxiety that might affect their mental health.
- (3) There should be adjustments in task assignments to ensure appropriate workload.
- (4) Faculties should provide study spaces to support students appropriately for online learning in case of future outbreaks.

Limitations

- (1) Larger sample size and further qualitative studies are required to understand the causes of mental health problems and more in depth.
- (2) This study is only a short-term survey study. Further long-term studies should be conducted to support the results of the study.
- (3) This study did not collect data from the sample before the outbreak, so there are no comparative data to clearly demonstrate the relationship between each factor.

CONCLUSIONS

The online learning factors, particularly the hours spent on assignments, and health behavior factors were related to the mental health status of dental students.

This research has provided the factors that contribute to mental health problems in dental students during disease epidemics as well as future opportunities for online education development and support programs, thus allowing for future positive mental health of dental student outcomes.

Authors contributions

NK contributed to the development of the study design, data interpretation, and manuscript preparation. KW, TW, WK, and YH participate in data collection and data analysis.

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Conflicts of interest

There are no conflicts of interest.

Authors contributions

Not applicable.

Ethical policy and Institutional Review Board statement

Ethical approval of this study was obtained from Board of Human Research Ethics Committee of Srinakharinwirot University, before it commenced. (Approval number: SWUEC/E-053/2565, Date of approval April 4, 2022).

Data availability statement

The data set used in the current study is available upon request at nathawut@g.swu.ac.th.

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