MEDICAL SCIENCE MONITOR

CLINICAL RESEARCH

e-ISSN 1643-3750
© Med Sci Monit, 2024; 30: e944932
DOI: 10.12659/MSM.944932

Received: 2024.04.24
Accepted: 2024.06.03
Available online: 2024.06.11
Published: 2024.06.24

Impact of COVID-19-Induced Academic Stress on Insomnia and Suicidal Ideation among Taiwanese Health Trainees and Junior Doctors

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Financial support: This study was supported in part by a research grant from the National Science and Technology Council, Taiwan (NSTC 113-2321-B-006-007)

Conflict of interest: Dr. Potenza has consulted for Opiant Therapeutics, Game Day Data, the Addiction Policy Forum, AXA, Baria-Tek, and Idorsia Pharmaceuticals; has been involved in a patent application with Yale University and Novartis; received research support from Mohegan Sun Casino and the Connecticut Council on Problem Gambling; participated in surveys, mailings, or telephone consultations related to drug addiction, impulse-control disorders, or other health topics; consulted for legal and gambling entities on issues related to impulse-control and addictive disorders; performed grant reviews for multiple funding agencies; edited journals and journal sections; given academic lectures in grand rounds, CME events, and other clinical/scientific venues; and generated books or chapters for publishers of mental health texts. The other authors report no disclosures

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Background: Clinical training for allied health trainees (AHTs) and postgraduate-year (PGY) doctors needed to go online during the outbreak of coronavirus disease 2019 (COVID-19), which may have caused academic stress and consequent outcomes among this cohort.

Material/Methods: To evaluate academic-related stress, clinical confidence, psychological distress, and insomnia, an online survey-based study was conducted among Taiwanese AHTs and PGY doctors between July and December, 2022, during the COVID-19 pandemic. The survey included the 21-item Depression, Anxiety, and Stress Scale (DASS-21), the Insomnia Severity Index (ISI), and self-designed questions. It was distributed using convenience sampling and snowball sampling and was completed by 522 participants.

Results: Structural equational modelling showed that academic stress was negatively associated with clinical confidence (standardized coefficient [β]=-0.382, $p<0.001$). Clinical confidence was negatively associated with psychological distress (β=-0.397, $p<0.001$), which was associated with insomnia (β=0.648, $p<0.001$). Additionally, clinical confidence and psychological distress were the significant mediators. Results indicated that higher academic stress was associated with higher level of insomnia via the mediation of clinical confidence and psychological distress.

Conclusions: Academic stress related to changes in clinical training may have led to insomnia among AHTs and PGY doctors during the pandemic. Factors to reduce academic stress should be investigated to promote good mental health while providing sufficient clinical training, especially during events that can cause increased stress (eg, epidemics, pandemics).

Keywords: COVID-19 • Sleep Initiation and Maintenance Disorders • Students, Medical • Suicidal Ideation • Teaching

Full-text PDF: https://www.medscimonit.com/abstract/index/idArt/944932

Introduction

The worldwide pandemic of the novel coronavirus 2019 disease (COVID-19) changed the world in many ways. The fear of getting infected [1] and health policies designed to maintain spatial distance [2] changed individuals' lifestyles, which in turn may have increased psychological burdens [2,3] and associated behaviors (eg, sleep disturbance, problematic internet use) [1-4]. During the pandemic, medical education may also have negatively affected psychosocial health [5]. Medical educators had to change their curricula from hands-on clinical practice to online learning to inhibit the spread of contagious features of new variants of the SARS-CoV-2 virus [6,7]. The postponements and disruptions to clinical training were likely to have exacerbated psychological stress among allied health trainees (AHTs) and postgraduate-year doctors (PGY doctors) who typically receive full-time in-person clinical training in the hospitals. Due to pandemic-related restrictions, in-person clinical training was replaced by remote online learning. However, the consequent impact has not yet been investigated.

In Taiwan, a minimum of 1 year of clinical training is required before graduation for medical professionals [8]. Clinical training has historically been an important process for AHTs and PGY doctors to apply learned knowledge into clinical practice by allowing direct contact with actual patients so they can practice their clinical skills and cultivate clinical decision-making within the supervision of seniors [7]. However, clinical training was severely impacted during the pandemic because the total number of medical staff in hospitals was strictly controlled. Moreover, personal protection equipment was only provided for healthcare staff with the greatest likelihood of contracting the virus (ie, frontline workers). Medical trainees had to take turns to go into hospitals to conduct their clinical training. In addition, potential patients avoided going to hospitals because of their fear of infection. This decrease in patient numbers also reduced the opportunities of medical trainees to practice their clinical skills on different types of medical injuries and diseases. In some hospitals, in-person medical training for interns was suspended for months. In addition, meetings, case discussions, and some demonstrations were conducted online or by watching videos. All opportunities for immediate interaction with their clinical tutors concerning hands-on clinical training were therefore limited.

These changes in educational learning modes (from in-person hands-on practice to online learning) may have negatively impacted clinical training. The AHTs and PGY doctors may have experienced academic stress because their clinical skills were not sufficiently practiced or rehearsed during such an important period in their training. Medical students receiving clinical training during the COVID-19 pandemic reported that

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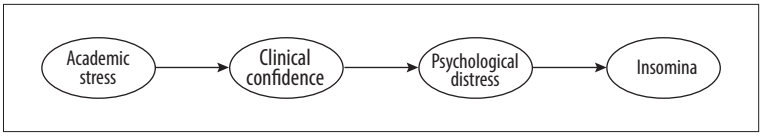

Figure 1. A proposed model to examine the relationships between study variables. *This figure was created using PowerPoint 365, Microsoft.*

postponements and/or switches to online clinical training severely impacted their interactions with medical colleagues and the opportunities to practice clinical skills [9,10], which affected the efficacy of clinical training [5,11] and generated increased anxiety and depression [11].

Despite medical students often having exam-based assessments for clinical competence, they may still lack confidence in the clinical practice of medicine [12]. Confidence is a subjective concept referring to individuals' actions or behaviors derived from their knowledge and skills [13]. Hands-on experiences are often effective in improving the confidence of medical students [13]. Unfortunately, during the pandemic, the opportunity to practice in clinical settings was disrupted by changes in educational formats [10], resulting in less exposure to clinical settings, which can lead to less confidence [14]. Related concerns and stresses experienced by AHTs and PGY doctors may have hampered development of their clinical skills and career progression [15], perhaps further straining their psychological health [5].

During the COVID-19 pandemic, poor psychological health was associated with multiple factors [1-4], including insomnia [16,17], among healthcare workers. As a common form of psychological distress during clinical training, depression can have bidirectional effects with medical errors [18]. With changes in clinical training, AHTs and PGY doctors may have experienced even greater psychological distress than normal, which may have subsequently negatively impacted care of their patients. Therefore, there is an urgent need to understand current relationships between psychological health and clinical training among AHTs and PGY doctors during times of pandemic-related changes in training, especially as the COVID-19 pandemic is unlikely to be the last.

Therefore, a survey-based study was conducted among Taiwanese AHTs and PGY doctors between July and December 2022, during the COVID-19 pandemic, using a series of self-designed questions, the 21-item Depression, Anxiety and Stress Scale (DASS-21), and the Insomnia Severity Index (ISI) to evaluate their academic-related stress, clinical confidence, psychological distress, and insomnia. The research model is illustrated in **Figure 1**. It was hypothesized that among AHTs and PGY doctors, perceived academic stress would be negatively associated with clinical confidence and that clinical confidence would be negatively associated with psychological distress, which would be positively associated with insomnia. In addition, the mediating effects involving clinical confidence and psychological distress were explored.

Material and Methods

Ethics

The study protocol was approved by the National Cheng Kung University Human Research Ethics Committee (Approval No. NCKU HREC-E-111-325-2). All participants gave their informed consent prior to their participation in the present study according to the Declaration of Helsinki. The online survey created by *SurveyMonkey* included an e-consent form and survey questions. By clicking "yes" on the e-consent form, participants gave their consent to participate and start the survey. By clicking "no", the survey immediately ended.

Participants and Procedure

A cross-sectional study was conducted using convenience sampling and snowball sampling between July and December 2022. The research team contacted medical and allied health-related departments/units in Taiwan universities and hospitals to distribute an online survey via a QR code or weblink. The survey stated that participants were welcome to disseminate it to those who met study eligibility. The participants completed the survey anonymously. No personal identifying information regarding participants was collected and all those participating were guaranteed that their data were confidential. Individuals were eligible to participate if they met the inclusion criteria: (i) aged 20 years or above, (ii) had majored in medical-related subjects, (iii) had conducted clinical training in a hospital from 2020 to 2021, and (iv) were able to read Chinese. Questions such as "*I am majoring in a healthcare-related specialty*" and evaluation of their major subject of study were asked to verify participants' eligibility. A total of 524 responses were initially collected. After screening for eligibility, 2 participants who reported their majors as non-medical specialties were excluded. Therefore, the responses of 522 participants were included in the analysis.

Measures

Demographic information was collected including age, gender, and major area of study (medicine, nursing, pharmacology, social worker, occupational therapy, physical therapy, medical science and biotechnology, and other). In addition, the level of independence was examined among variables including academic stress, clinical confidence, and psychological distress, as well as the outcome variables of insomnia. All the survey questions together with the construct validity of all the measures using confirmatory factor analysis are shown in **Tables 1 and 2**.

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Table 1. Fit indices of confirmatory factor analysis.

Fit indices	Values	Recommendation for good fit
χ^2(df)/p-value	639.892 (620)/0.282	Nonsignificant
CFI	0.999	>0.9
TLI	0.999	>0.9
RMSEA	0.08	<0.08
90% CI of RMSEA	0.000, 0.016	–
SRMR	0.054	<0.08

CFI – comparative fit index; TLI – Tucker-Lewis index; RMSEA – root mean square error of approximation; CI – confidence interval; SRMR – standardized root mean squared residual.

Table 2. Factor loadings for each item embedded in respective constructs with item contents.

Construct (scoring methods) Item content	Factor loading
Academic stress (1=disagree, 3=agree, the scores was averaged)	
Online learning has made learning a burden	0.702
Online learning is difficult to understand	0.763
Online learning lacks teaching materials	0.838
Clinical confidence (1=not worried at all, 5=extremely worried, the scores was averaged)	
How much do you worry about your clinical learning?	0.759
How much do you worry that you may fail the Professional and Technical Personnel Examinations?	0.757
How much do you worry about your future clinical competence?	0.911
How much do you worry that your clinical learning may become online learning?	0.681
How much do you worry that you may not have hands-on practice with patients?	0.686
Depression, Anxiety and Stress Scale-21 (DASS-21) (0=never; 3=almost always, the scores were summed)	
I found it hard to wind down	0.698
I was aware of dryness of my mouth	0.506
I couldn't seem to experience any positive feeling at all	0.704
I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0.632
I found it difficult to work up the initiative to do things	0.691
I tended to over-react to situations	0.690
I experienced trembling (eg, in the hands)	0.494
I felt that I was using a lot of nervous energy	0.746
I was worried about situations in which I might panic and make a fool of myself	0.798
I felt that I had nothing to look forward to	0.759
I found myself getting agitated	0.808
I found it difficult to relax	0.768

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Table 2 continued. Factor loadings for each item embedded in respective constructs with item contents.

Construct (scoring methods) Item content	Factor loading
I felt down-hearted and blue	0.776
I was intolerant of anything that kept me from getting on with what I was doing	0.689
I felt I was close to panic	0.697
I was unable to become enthusiastic about anything	0.726
I felt I wasn't worth much as a person	0.556
I felt that I was rather touchy	0.714
I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0.627
I felt scared without any good reason	0.700
I felt that life was meaningless	0.588
Insomnia Severity Index (ISI) (0=none/no disturbing at all, 4=very severe/extremely disturbing, the scores were summed)	
Difficulty falling asleep	0.731
Difficulty staying asleep	0.788
Problems waking up too early	0.658
How SATISFIED/DISSATISFIED are you with your CURRENT sleep pattern?	0.729
How NOTICEABLE to others do you think your sleep problem is in terms of impairing the quality of your life?	0.746
How WORRIED/DISTRESSED are you about your current sleep problem?	0.634
To what extent do you consider your sleep problem to INTERFERE with your daily functioning (e.g., daytime fatigue, mood, ability to function at work/daily chores, concentration, memory, mood, etc.) CURRENTLY?	0.852

Academic Stress

Academic stress was defined as the individuals' perceived stress derived from their academic performance [19] and assessed by 3 self-designed items rated on a 3-point Likert-like scale (1=disagree, 3=agree). The scores were averaged to generate a total score ranging from 3 to 9, with higher scores reflecting more perceived stress. A sample item is *"The online learning because of COVID-19 made learning a burden."* The items demonstrated good internal consistency in the present study (Cronbach's [α]=0.81).

Clinical Confidence

Clinical confidence was defined as an individual's dependence on their competence during clinical practice [20] and was assessed by 5 self-designed items rated on a 5-point Likert-like scale (1=not worried at all, 5=extremely worried). The scores were averaged to generate a total score ranging from 1 to 5, with higher scores reflecting higher levels of concerns regarding clinical skills. A sample item is *"How much do you worry about your future clinical skills?"* The items demonstrated good internal consistency in the present study (α=0.87).

Depression, Anxiety, and Stress Scale (DASS-21)

The DASS-21 developed by Lovibond and Lovibond [21] was used to assess individuals' psychological distress. The DASS-21 contains 21 items (eg, *"I found it hard to wind down"*) rated on a 4-point Likert-like scale (0=never; 3=almost always). The overall DASS-21 scores were calculated by summing the total 21 items to generate a total score ranging from 0 to 63. A higher score reflects greater psychological distress. The psychometric properties (including construct validity, concurrent validity, test–retest reliability, and internal consistency) of the Chinese version of the DASS-21 have been found to be satisfactory in prior research [22], and the items demonstrated excellent internal consistency in the present study (α=0.95).

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Table 3. Participant characteristics (N=522).

	Mean (SD) or n (%)	
Age, years	24.5	(3.6)
Gender (Male)	188	(36.02)
Major subject of study		
Medicine	195	(37.36)
Nursing	101	(19.35)
Pharmacology	67	(12.84)
Social Work	3	(0.57)
Occupational Therapy	65	(12.45)
Physical Therapy	51	(9.77)
Medical Science and Biotechnology	7	(1.34)
Other	33	(6.32)
Academic stress (range from 1-3)	1.88	(0.64)
Clinical confidence (range from 1-5)	3.14	(0.96)
Psychological distress (DASS-21; range from 0-63)	9.46	(10.61)
Insomnia (ISI; range from 0-28)	6.92	(5.00)

DASS-21 – 21-item Depression, Anxiety, Stress Scale; ISI – Insomnia Severity Index.

Table 4. Correlations between study variables (N=522).

	1	2	3	4
1 Academic stress	–			
2 Clinical confidence	**-.298 (<.001)**	–		
3 Psychological distress	**.149 (.001)**	**-.327 (<.001)**	–	
4 Insomnia	**.096 (.028)**	**-.282 (<.001)**	**.583 (<.001)**	–

Insomnia Severity Index (ISI)

The ISI developed by Morin (1993) [23] was used to assess individuals' level of insomnia [24]. The ISI contains 7 items (eg, *"How worried/distressed are you about your current sleep problem?"*) rated on a 5-point Likert-like scale (0=none/no disturbing at all, 4=very severe/extremely disturbing). The item scores were summed to generate a total score ranging from 0 to 28. A higher score reflects more severe insomnia. The psychometric properties (including construct validity, concurrent validity, and test–retest reliability) of the Chinese version ISI have been found to be satisfactory in prior research [25]. The items demonstrated good internal consistency in the present study in the present study (α=0.89).

Statistical Analysis

Descriptive analyses were used to understand baseline characteristics of participants and scores of study variables, and Pearson's correlation coefficients were used to calculate bivariate correlations between study variables. Construct validity of all the instruments used in the present study was examined using confirmatory factor analysis. In addition, structural equational modelling (SEM) with an estimator of diagonally weighted least squares was used to examine the fitness of the proposed model. Age and gender were controlled for as confounding factors in the model [26,27]. To test the supportiveness of the proposed models, 4 fit indices were used: the comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean squared residual (SRMR) [28]. The level of CFI and TLI should be higher than 0.9 [29]. The level of RMSEA and SRMR should be lower than 0.07 and 0.08 [29]. The mediation effect was further examined using 599 bootstrapping resample method to ensure a precise estimation [30]. The indirect effect was considered significant if 95% bootstrapping confidence interval does not include 0 [31]. The *lavaan* package in R software [32] was used to perform the SEM and SPSS 26.0 (IBM, Armonk, New York) to conduct other data analyses. A *p*-value less than 0.05 was considered statistically significant.

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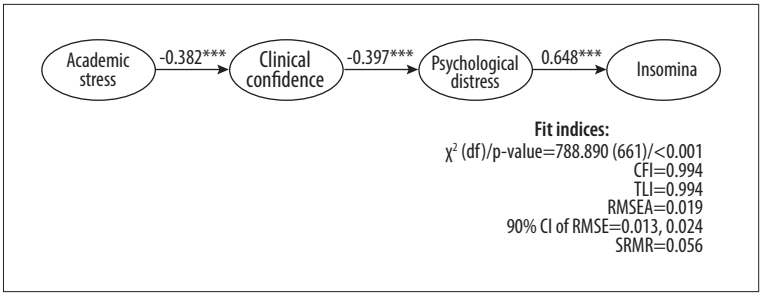

Figure 2. Results of structural equation modelling testing of the proposed model (N=522). CFI – comparative fit index; TLI – Tucker-Lewis index; RMSEA – root mean square error of approximation; CI – confidence interval; SRMR – standardized root mean squared residual. Solid lines indicate significant direct effects, which were observed for all relationships. *** $p<0.001$. *This figure was created using PowerPoint 365, Microsoft.*

Sample Size Estimation

Because the SEM was the main statistical method used in the present study, the sample size was estimated using the SEM rules-of-thumb in determining the required sample size. The rules-of-thumb used were: (i) a minimum of 100 participants [33] and (ii) at least 10 participants per variable [34]. Given that there were 4 study variables (academic stress, clinical confidence, psychological distress, and insomnia), the present study required at least 100 participants.

Results

Baseline Characteristics and Correlations Between Study Variables

Participant characteristics (N=522) are listed in **Table 3**. Participants had a mean age of 24.5 years (SD=3.6), and 36.02% were male. More than half majored in medicine (n=195, 37.36%) or nursing (n=101, 19.35%). Participants who reported "other" (n=33, 6.32%) majored in respiratory therapy (n=22, 4.21%), Chinese medicine (n=6, 1.15%), dentistry (n=3, 0.57%), and speech therapy (n=2, 0.38%). The correlations between study variables (academic stress, clinical confidence, psychological distress, and insomnia) are shown in **Table 4**. All study variables were significantly correlated with each other ($|r|$=0.096 to 0.583). Construct validity was supported by good fit indices and moderate to strong factor loadings (**Tables 1, 2**).

Fitness and Associations of Proposed Model

The SEM model (**Figure 2**) was well-fit as indicated by all fit indices (CFI=0.994, TLI=0.994, RMSEA=0.019, and SRMR=0.056). Specifically, academic stress was negatively associated with clinical confidence (standardized coefficient [β]=-0.382, $p<0.001$). Clinical confidence was negatively associated with psychological distress (β=-0.397, $p<0.001$). Psychological distress was positively associated with insomnia (β=0.648, $p<0.001$).

Mediation Effect

Additionally, mediation effects of clinical confidence and psychological distress are shown in **Table 5**. The results suggested that all associations between academic stress and insomnia were significantly mediated by clinical confidence (β=0.152, 95% bootstrap confidence interval [CI]=0.093, 0.229) and psychological distress (β=-0.248, 95% bootstrap CI=-0.340, -0.166), respectively. Moreover, sequential mediating effects of clinical confidence and psychological distress were also found (β=0.098, 95% bootstrap CI=0.059, 0.153).

Discussion

The present study investigated academic stress, clinical confidence, psychological distress, and insomnia among Taiwanese AHTs and PGY doctors during the COVID-19 pandemic. The

Table 5. Mediation effects in the proposed model.

Independent variable	Mediator(s)	Outcome variables	Stand. coeff.	95% Bootstrap Confidence interval	
				Lower limit	Upper limit
Academic stress	Clinical confidence	Insomnia	0.152	0.093	0.229
	Psychological distress		-0.248	-0.340	-0.166
	Clinical confidence followed by psychological distress		0.098	0.059	0.153

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results showed that higher academic stress was associated with higher insomnia via the independent or sequential mediation of clinical confidence and psychological distress.

The present study's findings provided evidence regarding the associations between academic stress, clinical confidence, and psychological distress. Previous studies have reported increased concerns about opportunities to practice during the COVID-19 pandemic among medical trainees from different specialties [10,35]. Those with higher concerns regarding missing clinical opportunities were reported as having a higher likelihood of experiencing emotional burnout [35]. Additionally, studies have reported that changes in medical training both before and during the pandemic threaten the competence of independent practice among medical trainees [14,36], which concurred with the findings of the present study. Independent decision-making has been described as a critical factor contributing to the development of clinical confidence during clinical training [37]. Second opinions from the seniors may act as a 'safety net' to allow medical trainees to take risks within a supervised setting [37]. In addition, training satisfaction has been reported to positively predict confidence among AHTs and PGY doctors regarding their future clinical careers [15]. However, changes in educational formats due to the COVID-19 pandemic [6,7] limited the in-person opportunities of medical trainees to provide hands-on care to patients [37], limiting their opportunities to be guided [38] and make clinical decisions [37]. Such an unexpected change in clinical practice may have subsequently affected the clinical confidence of medical freshmen and jeopardized their medical careers, which highlights the importance of optimizing clinical training during events such as the COVID-19 pandemic.

The association between psychological distress and insomnia is well-established [39,40] and was also found in the present study. Psychological distress has frequently been reported by medical trainees during clinical training [41,42]. During the COVID-19 pandemic, some of the psychological distress of medical trainees may have been derived from a series of uncertainties caused by the suspension or cancellation of their medical training programs [15]. A previous study further found that medical trainees had the highest level of psychological distress when compared to medical staff, patients with COVID-19, and the general population [43] during the COVID-19 pandemic. In addition, another study reported that medical trainees who had irregular clinical training during the COVID-19 pandemic showed significantly higher (3-fold) prevalence of insomnia when compared to those with regular clinical training [44], supporting the strong association between psychological distress and insomnia [14,15]. Both psychological distress [45] and insomnia [46] are frequently found in physicians committing medical errors, which can further jeopardize clinical confidence of medical and allied health practitioners [47] and subsequently form a vicious cycle that further affects their medical careers. Moreover, insomnia was reported as a mediator to advance medical events. Insomnia has been reported to mediate the association between secondary trauma derived from COVID-19 (indirect exposure to trauma via the patients' experience) and mental health concerns [48] and may exacerbate the severity or intensity of health-threatening events such as suicidal ideation [40,49,50], or addictive behaviors [3,39]. With the additional impact of the pandemic, these negative factors (psychological distress and insomnia) may have an "added-on effect" in negatively affecting health [39,40,49-51] that warrants particular attention.

The present study demonstrated the negative impact of academic stress, and the findings echo previous research examining insomnia among medical and allied health practitioners. Given that there may be other new viruses that cause worldwide or regional pandemics in the future (eg, there was only a 16-year gap between the SARS epidemic in 2003 [52] and the COVID-19 pandemic in 2019), efforts to reduce such negative educational outcomes and psychological distress, as well as the development of appropriate practices and interventions, are of ongoing importance. Clinical education in the future is likely to encounter similar difficulties, and the education system needs to well prepared for possible difficulties encountered in the future. Moreover, many teaching practices have changed since the COVID-19 pandemic, with an increase in online teaching, a type of teaching practice that may negatively affect students' mental health in some disciplines more than in others. Consequently, therapeutic resilience strategies such as mindfulness or meaning-centered therapy [53] may benefit AHTs and PGY doctors experiencing stress and subsequently reduce negative outcomes. Future studies may further investigate specific factors that can cause academic stress (eg, education learning modes, frequency of practice, and guidance from senior practitioners) to provide better clinical training and support, especially during crises that can alter individuals' educational opportunities. Also, it is important to consider social responsibility of the AHTs and PGY doctors when providing the teaching practices [54,55].

The present study has several limitations. First, the cross-sectional study design cannot demonstrate causal relationships. Second, the self-reported measures are prone to social desirability and other biases. Third, data regarding clinical confidence and other measures from AHTs and PGY doctors who experienced clinical training were not collected before the COVID-19 pandemic. Fourth, for a small number of participants, there were months between conducting the survey and the time when their clinical training experience occurred, which may have resulted in some recall bias. Fifth, the actual details of participants' clinical training (eg, the duration of in-field practice and online learning) was not assessed, which may have affected the findings. Sixth, regional information from participants

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regarding where they had their clinical training was not collected. In Taiwan, different districts experienced different levels of COVID-19-related impacts and changes. Such differences may have caused different levels of impact on clinical training.

Conclusions

The present study found that higher academic stress was associated with a higher level of insomnia among Taiwanese AHTs and PGY doctors during the COVID-19 pandemic. Moreover, this association was independently or sequentially mediated by clinical confidence and psychological distress. Mindfulness meditation and health status monitoring may be helpful for reducing psychological distress, and this possibility warrants future research. Future studies should investigate factors that can lead to academic stress, such as education learning modes or the opportunities for in-person patient practice and interaction, to provide optimal clinical experiences for AHTs and PGY doctors during changes in training related to events such as the COVID-19 pandemic.

Department and Institution Where Work Was Done

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Acknowledgements

The authors wish to thank Dr. Thy-Sheng Lin, the Deputy Superintendent of National Cheng Kung University Hospital, for his support for participant recruitment.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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