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College students' sleep difficulty during COVID-19 and correlated stressors: A large-scale cross-sessional survey study

Chia-Wei Fan [a],*, Kathryn Drumheller [a], I-Hua Chen [b,c], Hsin-Hsiung Huang [d]

[a] Department of Occupational Therapy, AdventHealth University, Orlando, Florida, USA
[b] Chinese Academy of Education Big Data, Qufu Normal University, Qufu City, Shandong, China
[c] International College, Krirk University, Bangkok, Thailand
[d] Department of Statistics and Data Sciences, University of Central Florida, Orlando, Florida, USA

ABSTRACT

Objective: Sleep difficulty is one of the main concerns during the COVID-19 pandemic. This study examined factors related to vaccination and physical and psychological health conditions, and sleep difficulty in college students in China.

Methods: An online, cross-sectional, anonymous survey was used to investigate college students' perceived sleep difficulty and relevant components (i.e., physical health condition, psychological distress, knowledge of vaccine, and autonomy of vaccine uptake). Hierarchical ordinal logistic regression was conducted to examine the proposed model with the control of participants' demographics (i.e., gender and age).

Results: Valid data of 3,145 students from 43 universities in mainland China was collected in January 2021. The average age of participants was 20.8 years old (S. D. = 2.09). The majority were single (97.4%), and about half were male (49.8%). Results showed that participants had less psychological distress when they had more knowledge about the COVID-19 vaccine and more autonomy to decide whether to receive it. In addition, participants with better physical health experienced less sleep difficulty. In contrast, those with more psychological distress experienced more sleep difficulty.

Conclusions: These findings can inform healthcare providers about the relationship between different factors and difficulty sleeping and aid them in developing interventions addressing sleep difficulties associated with the global pandemic. Health authorities also can improve vaccine uptake and reduce hesitancies in future vaccination campaigns based on the study results showing that greater vaccine knowledge and autonomy reduced psychological distress.

1. Introduction

The COVID-19 virus started in December 2019 as an outbreak in China [1] and eventually spread around the globe to be declared as a public health emergency. Then, World Health Organization (WHO) officially characterized COVID-19 as a global pandemic on March 11, 2020 [1]. Psychological distress, such as anxiety, depression, and unprecedented uncertainty, has been experienced worldwide, posing a global threat to mental well-being and psychological health [2]. Many populations have identified sleep difficulty as one of their top concerns during the pandemic [3]. For example, Lin and colleagues [4] found that healthcare workers and adults from the general population reported insomnia symptoms at the beginning of the outbreak. Other studies focusing on healthcare employees, who worked directly with clients diagnosed or at risk of COVID-19, showed even significantly higher rates of insom-

nia, anxiety, and depressive symptoms [5–7]. Alimoradi and colleagues [8] conducted a systematic review and meta-analysis which revealed healthcare professionals, the general population, and COVID-19 patients did not significantly differ in sleep problems from one another when these factors were analyzed by gender, even though the prevalence rate of sleep difficulty was higher for these three groups, particularly during lockdown measures. In another systematic review and meta-analysis, Alimoradi and colleagues [9] discovered a pooled estimated prevalence of 37% for sleep problems during the outbreak. When the data was further analyzed by sample subgroups (i.e., healthcare professionals, general population, COVID-19 patients), the corrected pooled estimated prevalence demonstrated that 37% of healthcare professionals, 18% of the general population, and 57% of COVID-19 patients experienced problems with sleep [9]. Therefore, they concluded that sleep problems seem to be a common concern during the COVID-19 pandemic, with the compiled sample representing young adults the most [9]. Additionally, the meta-analysis revealed that greater levels of psychological distress (i.e., depression, anxiety) was associated with sleep problems [9]. Similarly, Jahrami and colleagues [3] conducted a systematic review and found

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* Corresponding author.
E-mail address: Chia-Wei.Fan@ahu.edu (C.-W. Fan).

that the global pooled prevalence rate of sleep difficulty among all populations was approximately 40% during the COVID-19 pandemic.

Several studies have found that psychological distress may predict a higher risk of sleep difficulty [10–11]. Since the pandemic, psychological distress has been highly prevalent around the world [12–16]. A large-scale survey study revealed that more than half of the general population reported that they experienced psychological distress starting in the early days of the lockdown [13]. Additionally, younger age groups (i.e., 15 to 24 years old), including the college student population, had the highest level of psychological distress in Belgium [13], China [17], and Italy [2] due to a greater reduction in social activity [18], and the resulting loneliness was a strong risk factor for psychological distress [19]. Lin and colleagues [4] found that anxiety and depression are the major results of the acute impact of the pandemic. Additionally, Lorant et al. [13] indicated that 40% of the general population declared that they felt less useful than usual.

Many factors can contribute to psychological distress. For example, the perceived level of knowledge relative to the COVID-19 vaccine could increase an individual's risk perception, increasing the level of psychological distress [20]. However, knowledge could also be associated with an increased capacity of avoiding risky behaviors and endorsing protective behaviors, such as avoiding crowds, wearing masks, keeping social distance, and receiving the COVID-19 vaccine [21], which, in contrast, might decrease psychological distress. Hogan et al. [22] found that the participants' knowledge of the COVID-19 vaccine will likely translate to a greater openness to getting vaccinated. In another study conducted in Bangladesh, the results showed that university or higher levels of education were associated with greater COVID-19 vaccine knowledge [23].

When considering vaccine injection, every individual should have the right to freely choose to receive the COVID-19 vaccine, i.e., to have individual autonomy over their body. Through focus groups and interviews, Visser et al. [24] identified that autonomy was an important component in choosing to accept a pertussis vaccine; participants expressed they would reject a vaccine offer absent the autonomy of choice because making decisions regarding their bodies was important to them. However, vaccine hesitancy, defined as "the reluctance or refusal to vaccinate despite the availability of vaccines," has been identified as one of the major threats to global health [25]. It has become an important issue in the COVID-19 pandemic. Furthermore, COVID-19 vaccine hesitancy was identified as the most prominent factor for psychological distress, such as anxiety, depression, and peritraumatic distress in Israel [26]. Previous research found that psychological reactance may cause psychological distress resulting from people's perceptions that rules or regulations might threaten one's autonomy and freedom of choice [27]. However, it is still unclear how the autonomy of choice in a vaccine decision is associated with psychological distress in the COVID-19 pandemic.

Additionally, physical health condition should also be considered with sleep difficulty. For example, shortness of breath or difficulty breathing is one of the main symptoms of COVID-19 [28]. In one study, Budhiraja et al. [29] found that patients with breathing problems had statistically higher levels of sleep difficulty than those without breathing problems. Additionally, physical health condition can cause acute or chronic pain [30], and research reported that more than 50% of clients with sleep difficulty suffer from chronic pain [31] or other medical disorders [29]. Furthermore, the varying quarantine and lockdown policies enforced in many countries during the pandemic were found to negatively affect people's behaviors in general, including their sleep patterns and their amount of physical activity, which decreased their physical health condition [32]. One study found that insufficient physical activity was a risk factor for disturbed sleep patterns [33]. Also, a study from Reunion Island suggested that young adults lacking physical activity and disrupted sleep experienced an impaired quality of life [34].

A study conducted by the Centers for Disease Control and Prevention (CDC) indicated that the national weekly COVID-19 incidence among people aged 18–22 years (e.g., college students) increased 62.7% in Au-

gust 2020 [35]. However, college students are generally considered a low-risk population and were not prioritized for vaccination or COVID-19 studies. Consequently, college students may have a varied understanding of vaccination information. They may not be fully aware of how their knowledge and desire for autonomy of uptake might cause underlying psychological distress. In addition, both physical health condition and psychological distress might play a consequential role in sleep difficulty. Therefore, it is extremely important to include college students as research participants and understand their perspectives during the COVID-19 pandemic. The current study aims to examine the following hypotheses:

Hypothesis 1 (H1): Knowledge concerning the COVID-19 vaccine will be associated with psychological distress.

Hypothesis 2 (H2): Autonomy of COVID-19 vaccine injection will be associated with psychological distress.

Hypothesis 3 (H3): Psychological distress will be positively associated with sleep difficulty.

Hypothesis 4 (H4): Physical health condition will be negatively associated with sleep difficulty.

2. Materials and methods

2.1. Participants and recruitment procedures

The current study used an online questionnaire and targeted college students as the main participants. The research team contacted counselors at mainland China colleges to help recruit students. The study's purposes and procedures were shared with these individuals. After the initial contact, study materials were disseminated to the forty-three counselors who agreed to help. Two inclusion criteria were used in the current study: (a) participants needed to be undergraduate or graduate students studying in a college program in mainland China, and (b) participants needed to be age 18 years or older.

The college counselors then helped launch the online survey and disseminated the study information to their corresponding students in each school. The online survey was self-administered, avoiding direct contact between researchers and participants. Students in this study were informed that participation was voluntary and data collection was confidential and anonymous. Informed consent was obtained before the participants could further access the study's survey. Once the data collection commenced, the enrolled students had ten days to complete the survey. The data was collected at the beginning of January 2021, one year after the COVID-19 outbreak. The Institutional Review Board of the Jianxi Psychological Consultant Association (IRB ref: JXSXL-2020-DE22) approved the study proposal before data collection began. Enrolled participants completed all the survey items, given that the survey platform did not allow missing answers. Therefore, no missing data were observed in the study.

2.2. Assessments

2.2.1. Knowledge of COVID-19 vaccine measure

Three items were used to measure the participants' knowledge about the COVID-19 vaccine with the seven-point Likert scale (1 = Strongly disagree; 2 = Disagree; 3 = Somewhat disagree; 4 = Neutral; 5 = Somewhat agree; 6 = Agree; 7 = Strongly agree). These three items are: "I know very well how vaccination protects me from the COVID-19", "I understand how the COVID-19 jab helps my body fight the COVID-19 virus", and "How the COVID-19 jab works to protect my health is a mystery to me". The last item was negatively worded, so the scorings for this item were reversed. Sum of these three items was used as the latent variable to indicate participants' knowledge of vaccine uptake. A higher score indicates a better knowledge and understanding of the COVID-19 vaccine. The three items had good internal consistency ($\alpha = 0.84$).

2.2.2. Autonomy of vaccine uptake measure

The participants' perceived autonomy regarding uptake of the COVID-19 vaccine was assessed by three items with the seven-point Likert scale (1 = Strongly disagree; 2 = Disagree; 3 = Somewhat disagree; 4 = Neutral; 5 = Somewhat agree; 6 = Agree; 7 = Strongly agree). These three items are: "I can choose whether to get a COVID-19 jab or not", "I feel under pressure to get the COVID-19 jab" and "I get the COVID-19 jab only because I am required to do so". The last two items were negatively worded, so the scorings were reversed. Sum of these three items was used to represent the latent variable of participants' autonomy of vaccine uptake. A higher score indicates greater autonomy of uptake for the COVID-19 vaccine. The internal consistency of these three items was acceptable (α = 0.62).

2.2.3. Psychological distress measure

The participants' psychological distress was measured with four items (i.e., anxiety, irritability, depression, and feeling inferior to others) with the five-point Likert scale (1 = Not at all; 2 = Slightly; 3 = Moderate; 4 = Severe; 5 = Extremely). A sample item is "Please carefully recall and rate the degree of depression you experienced in the last week (including today)." A higher score indicates a higher level of psychological distress. The four items had excellent internal consistency (α = 0.94).

2.2.4. Physical health condition measure

One item, "In the past week, how was your physical health condition?" was used to evaluate the participants' perceived physical health condition using the five-point Likert scale (1 = significantly worse than others; 2 = worse than others; 3 = the same as others; 4 = better than other; 5 = significantly better than others). A higher score represents a better physical health condition.

2.2.5. Sleep difficulty measure

One item, "Please carefully recall and rate the degree of sleep difficulty you experienced in the last week (including today)," was used to measure the participants' sleep difficulty with the five-point Likert scale (1 = Not at all; 2 = Slightly; 3 = Moderate; 4 = Severe; 5 = Extremely). A higher score indicates a worse condition of sleep difficulty.

2.2.6. Background information measure

Demographic information, including the participants' age, gender, marital status, and educational level (undergraduate *vs.* graduate), was collected in the survey.

2.3. Data analyses

Descriptive statistics such as means, standard deviation, frequency, and percentage were used to analyze the participants' characteristics. As all of the study variables were measured as ordinal scales, Spearman's rho correlation coefficients were used to examine the zero-order associations between the variables. Finally, the ordinal logistic regression was used to examine the contribution of each independent variable toward the dependent variable (i.e., sleep difficulty). The Wald Chi-Square test was applied to examine the null hypothesis that the estimate equals 0 [36]. The α level was set at 0.05. More specifically, the proposed model is outlined in Fig. 1, where knowledge of vaccine and vaccine uptake autonomy are the explanatory factors underlying psychological distress; psychological distress along with physical health condition are the explanatory factors underlying sleep difficulty. All explanatory factors were constructed latently, except for those variables assessed only using one item (i.e., physical health condition and sleep difficulty). Additionally, the regression coefficient will be used to estimate increase in the log odds of the dependent variable per unit increase in the value of the independent variables. In this case, how would the psychological distress level change with the increase of vaccine knowledge (H1) and vaccine autonomy (H2) when all of the other variables in the model are held constant; also, how would the sleep difficulty level change with the

increase of psychological distress (H3) and physical health (H4) when all of the other variables in the model are held constant. Furthermore, the exponential function of the regression coefficient, the odds ratio (OR), will be reported with the 95% confidence interval (CI) [37].

3. Results

3.1. Demographics

This study consisted of 3,145 mainland Chinese students who study at one of the 43 participating colleges. The majority were undergraduate students (n = 3026, 96.2%). The average age was 20.8 years old (S. D. = 2.09), the majority were single (97.4%), and half were male (49.8%).

3.2. Psychological distress and vaccine knowledge and autonomy

Table 1 shows the strength and direction of existing associations between variables of the current study.

The results supported the hypotheses of correlations between psychological distress and vaccine knowledge and autonomy. The Wald Chi-Square test statistics for the COVID-19 vaccine knowledge and autonomy are 33.75 and 50.42, respectively, both with an associated $p < .001$. Therefore, we rejected the null hypotheses and concluded that the regression coefficients for vaccine knowledge and vaccine autonomy were found statistically different from zero in estimating psychological distress in the model. Based on Fig. 2, a one-unit increase in the college participants' COVID-19 vaccine knowledge, resulted in a .070 decrease ($p < .001$) in the log of odds of being in a higher psychological distress level when all other variables in the model are held constant. The odds ratio = .932 (95% CI = .911 to .954). Also, with a one-unit increase in the college participants' COVID-19 vaccine autonomy, resulted in a .087 decrease ($p < .001$) in the log of odds of being in a higher psychological distress level when all other variables in the model are held constant. The odds ratio = .917 (95% CI = .895 to .939). In other words, when the participants had more knowledge about the COVID-19 vaccine, they had less psychological distress (H1). Furthermore, when the participants had greater autonomy regarding COVID-19 vaccine uptake decisions, their psychological distress decreased (H2).

3.3. Sleep difficulty and psychological distress and physical health condition

The current results supported our hypotheses of correlations between psychological distress, physical health condition, and sleep difficulty. The Wald Chi-Square test statistic for psychological distress is 1638.49 with an associated $p < .001$. Additionally, the Wald Chi-Square test statistic for the physical health condition is 5.22 with an associated $p = .022$. Therefore, we rejected the null hypotheses and concluded that the regression coefficients for the psychological distress and the physical health condition were found statistically different from zero in estimating sleep difficulty in the model. Based on Fig. 2, a one-unit increase in psychological distress score in the college participants, resulted in a .543 increase ($p < .001$) in the log of odds of being in a higher sleep difficulty level when all other variables in the model are held constant. The odds ratio = 1.722 (95% CI = 1.677 to 1.768). Also, a one-unit increase in the physical health condition score, yielded a .098 decrease ($p = .016$) in the log of odds of being in a higher sleep difficulty level when all other variables in the model are held constant. The odds ratio = .907 (95% CI = .837 to .982). Therefore, the findings showed when the participants had more psychological distress, more sleep difficulty was found (H3). When the participants experienced better physical health condition, they had less sleep difficulty (H4).
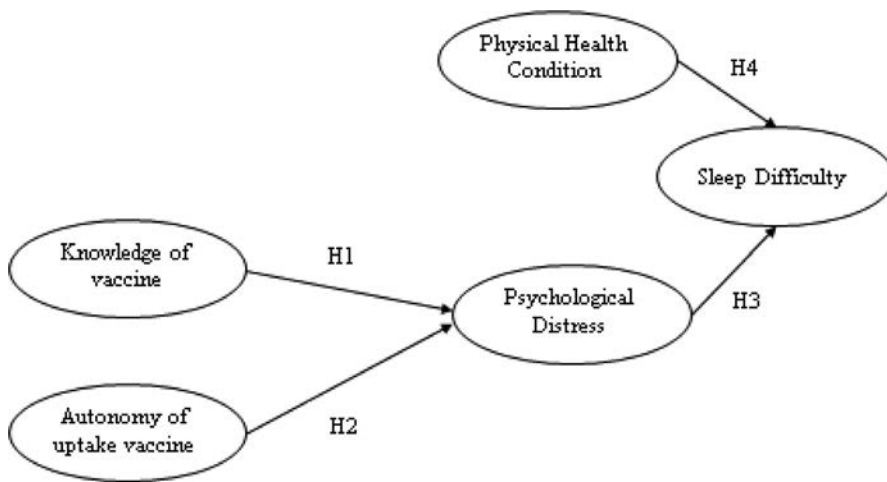
Fig. 1. The proposed model in explaining sleep difficulty among mainland Chinese university students.

Table 1

Descriptive Statistics and Correlation Matrix between Variables

	Mean (S.D.)	Spearman's rho				
		1.	2.	3.	4.	5.
1. Knowledge of vaccination	16.01 (2.96)	1				
2. Autonomy of vaccine uptake	15.06 (3.40)	-.386**	1			
3. Psychological distress	7.58 (4.05)	-.057**	-.085**	1		
4. Physical health condition	3.53 (0.95)	.043*	.073**	-.214**	1	
5. Sleep difficulty	1.94 (1.16)	-.008	-.075**	.752**	-.185**	1

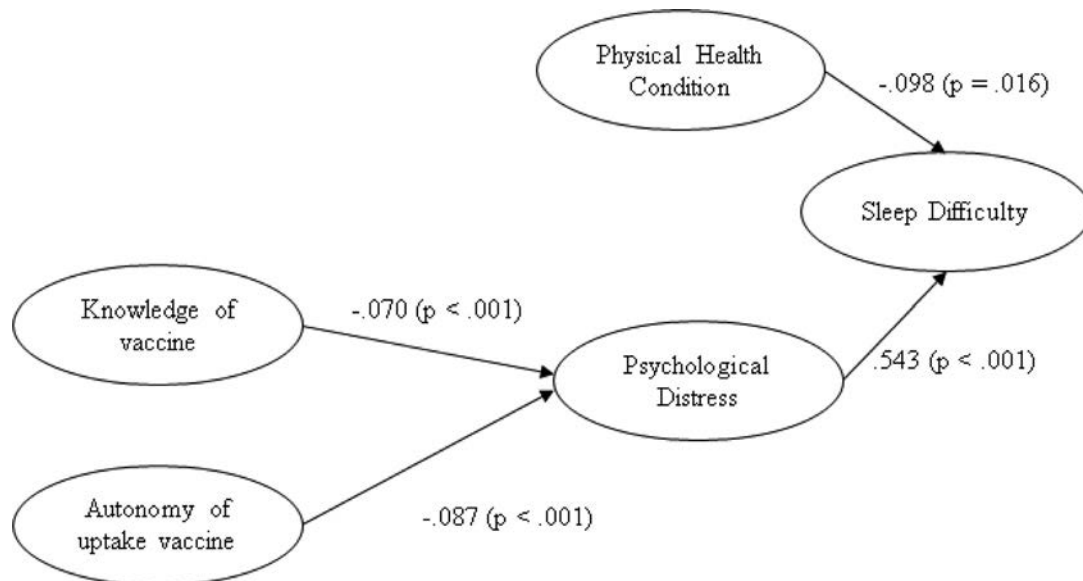*Note.* **$p < 0.01$; *$p < 0.05$

Fig. 2. Results of the proposed model in explaining sleep difficulty among mainland Chinese university students.

4. Discussion

The unprecedented circumstances and uncertainty created by the COVID-19 pandemic threaten the global community's psychological and physical well-being [2]. Difficulties with sleep have been a major concern throughout the pandemic, especially in the college population [38–39]. Thus, the current study examined the broad concept of sleep difficulty and its correlated factors among college students. The results supported our proposed model that college students' perceived knowledge about the COVID-19 vaccine, as well as their autonomy regarding COVID-19 vaccine uptake, predicted their psychological distress. Furthermore, we discovered that psychological distress (e.g., feeling more

or less autonomy-related anxiety regarding vaccine uptake), as well as physical health condition, were explanatory factors for sleep difficulty. These results were strengthened by the large enrollment of student participants representing 43 mainland China colleges and the application of sophisticated analytic methods. Detailed illustrations for our research findings are described below.

4.1. COVID-19 vaccination and psychological stressors: Impacts of knowledge and autonomy

The WHO identified vaccine hesitancy as a threat to the health of the global population [25]. Thus, willingness to be vaccinated against

COVID-19 is a major factor to consider for vaccine uptake [40]. With the emergence of numerous vaccines available worldwide to combat the current COVID-19 epidemic, we explored the impact of perceived knowledge and autonomy for vaccine uptake on psychological distress. College students in this study who demonstrated greater perceived knowledge about the COVID-19 vaccine reported lower levels of psychological distress, indicating that more information and experience with the subject may have reduced feelings such as depression, anxiety, irritability, and feeling inferior to others. In addition, Bai et al. [41] discovered that college students taking health-related courses were more apt to accept COVID-19 vaccination than college students taking non-health-related courses. Thus, the nature of health-related coursework may have increased the students' knowledge level and familiarity with vaccination and may explain the greater willingness to accept the COVID-19 vaccine.

Similarly, medical students reported a greater willingness to receive the COVID-19 vaccine than non-medical school students [42]. Furthermore, students familiar with the COVID-19 vaccine identified that vaccination is a safe and effective way to protect others and were more likely to accept a COVID-19 vaccination [41]. These results imply that greater knowledge about vaccines may be an important component to consider regarding vaccine uptake and decreasing vaccine hesitancy. A previous study showed that most of the distrust and concerns about the COVID-19 vaccines were driven by widespread, deliberate misinformation from online sources and skeptical communities [43]. Additionally, misinformation exposure was associated with a younger age (i.e., 20–29 years) and higher education levels (i.e., college education or above) [44], which was consistent with our study population. Another previous study showed that when people relied more on social media as their main news source, they were more likely to believe misinformation about the pandemic [45]. In addition, studies found that misinformation exposure was associated with psychological distress, such as anxiety, depression, and posttraumatic stress disorder symptoms [44,46]. This finding and ours aligned and confirmed Wang's and colleagues' [40] conclusions that educating the community about the vaccine is an important factor in increasing the willingness to receive the COVID-19 vaccination. Demonstrating to the public that the vaccine is both safe and effective [41,47] with undisputable data [48] may provide a way to overcome vaccine hesitancy and eventually reduce psychological distress.

Although vaccines are intended to minimize the worst disease outcomes, they are neither perfectly safe nor perfectly effective [49]. The severe consequences of the COVID-19 pandemic have stimulated discussions that approved vaccines should be made mandatory [50]. However, considering individual rights and ethics, mandatory vaccination has not been ruled out in most countries, and there are no clear guidelines to enforce population-wide vaccination requirements [51]. Grzybowski et al. [52] argued a way to avoid coercion and allow people to maintain personal autonomy regarding vaccine uptake is to hold people who refuse vaccinations financially responsible for any treatment costs accrued if they or their children fall ill with a vaccine-preventable infection. However, a lack of autonomy regarding decisions about vaccine uptake can lead to an emotionally heightened situation [53]. Our findings showed that the more personal autonomy participants felt regarding COVID-19 vaccine uptake, the lower their levels of psychological distress.

Conversely, when autonomy to choose is taken away, people experience psychological impacts, which was consistent with a previous study with the German population [53]. In Sprengholz et al.'s study [53], participants in a hypothetical scenario experienced significantly higher levels of psychological distress when they were told that they had no choice regarding the brand of COVID-19 vaccine they received. This lack of autonomy also significantly reduced by about 40% their willingness to be vaccinated [53]. Likewise, Visser et al. [24] discovered that reducing individuals' autonomy to decide about injecting a pertussis vaccine would result in rejection of the vaccine; participants voiced that it was important to make their own decisions. A similar attitude was identified in nurses in Israel [54]. Survey responses revealed that 64% of nurses felt

they should have the autonomy to decide about vaccine uptake, and 60% indicated they do not trust anyone else to decide for them regarding vaccine uptake [54]. Hakim et al. [55] also identified autonomy as a concern regarding mandatory vaccinations. In a survey of employees at St. Jude Children's Research Hospital, participants were asked about their thoughts regarding a mandatory influenza vaccination program. Among the participants against mandatory influenza vaccinations, violation of autonomy and freedom was rated as the top reason [55]. Therefore, autonomy and choice appear to be important factors for vaccine acceptance.

4.2. Psychological distress, physical health, and sleep difficulty

Multiple studies have shown that many people experienced sleep difficulty during the COVID-19 pandemic [3,56]. Therefore, assessing factors that contribute to sleep difficulty is important because compromised sleep may leave individuals more vulnerable to severe cases of COVID-19 [57]. Additionally, sleep difficulty may also affect the efficacy of COVID-19 vaccines [58]. Thus, the current study's findings that psychological distress, physical health condition, and sleep difficulty are associated with one another in college students are concerning due to the present state of the world.

Our results were consistent with previous studies that revealed sleep difficulty and psychological distress are related [59]. Furthermore, negative effects, such as anxiety, depression, and stress, predicted participants' sleep quality [56,60–62]. Notably, one study showed that participants who had been classified as good sleepers before the pandemic but rated their sleep poorly during the pandemic experienced even greater negative effects, such as irritability [56]. Another study found that when people were more depressed, they were less apt to follow safety recommendations regarding COVID-19 transmission [60], which jeopardizes their health and those around them. Additionally, psychological distress (e.g., depression, anxiety, irritability, etc.) and sleep difficulty are both critical risk factors for suicidality [59,63], especially among adolescents and young adults, including college students [64]. With the high prevalence rate of sleep difficulties during the COVID-19 pandemic, potentially increasing suicidality is a possible consequence worthy of future research [65].

Apart from psychological distress, the current study identified that the presence of physical health problems correlated to sleep difficulty in college students. Zhang et al. [66] also studied the impact of self-rated sleep parameters on the progression of COVID-19 in hospitalized adults with confirmed cases of COVID-19 and lymphopenia. They discovered that patients classified as poor sleepers required longer hospitalization stays and needed intensive care unit treatment at a significantly higher rate than those identified as good sleepers. In addition, their recovery from lymphopenia was significantly slower, increasing the patient's chance of critical illness [66]. Also, sleep loss may affect an individual's immune system, maybe explaining the association between reduced sleep duration and increased vulnerability to respiratory infections [67]. Donners et al. [68] discovered that college students who reported decreased immunity to pathogens had significantly poorer sleep quality than those who reported normal and healthy immunity to pathogens. Another study found that hospitalized COVID-19 patients with poorer physical health condition had a poorer sleep quality than their counterparts who had mild physical health issues [69]; furthermore, patients with fewer hours of sleep developed greater levels of organ damage [70]. Therefore, the above results were consistent with our findings that physical health condition correlates with clients' sleep difficulty.

4.3. Limitations and future study suggestions

A few limitations should be noted when interpreting the present study's results. First, although the study had a large sample size across

43 universities from China, the students comprised a convenience sample and participated voluntarily, thus restricting the generalizability of the present findings. Second, this study used a cross-sectional design and had no long-term follow-up. Given that information related to COVID-19 vaccines is released daily, students' knowledge and autonomy of vaccination, as well as their physical and psychological influences on sleep, might potentially change over time. However, the cross-sectional design prevents us from capturing such changes. Third, the current study measured college students' perceived vaccine knowledge; however, the perceived knowledge could not represent the actual knowledge. Therefore, future studies may want to explore how the objective knowledge base of college students might play a role in their psychological distress.

Furthermore, physical health condition and sleep difficulty were both measured with a single item. Therefore, the depth and breadth of these concepts were limited in interpretation. Lastly, the current study did not collect the students' majors, and thus, we cannot determine if the students' courses of study influenced their responses. Future studies could consider collecting longitudinal data, implementing an objective vaccine knowledge measurement, and expanding the survey items regarding physical health condition and sleep difficulty to enable severity and quality to be further quantified. Also, future studies could collect students' majors and explore their exposure to vaccination information to determine if it influences their objective knowledge or level of psychological distress. Additionally, the medical field functions based on patient choice and consent. Therefore, it may be interesting to see if students in health-related programs respond differently to COVID-19 vaccine uptake autonomy and psychological distress *vs.* students in other areas of study.

5. Conclusions

Based on our study results, empowering individuals with greater knowledge about the COVID-19 vaccine, and increasing their autonomy regarding vaccine uptake, may be one way to reduce psychological distress and resulting sleep problems. Effective screening procedures should be developed to identify students who experience psychological distress and unstable physical health condition. Additionally, COVID-19 vaccination health education activities should be specifically directed toward increasing awareness and knowledge in the student population. When encountering college students who express vaccine hesitancy, interpersonal communication should be considered as each individual's need is unique. Immediate and suitable interventions should be provided to help them cope with sleep difficulty. Additionally, proper physical activity and psychological consultation should be considered and incorporated into school counseling programs to improve students' sleep quality during the COVID-19 pandemic.

Declarations of Competing Interest

The authors certify that there are no declarations of interest involved in this study. No financial support of this research is identified for this study.

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