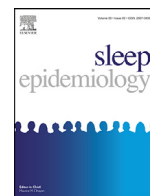




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The association between problematic internet use, psychological distress, and sleep problems during COVID-19



1. Introduction

1.1. Pandemic outbreak during the information age

The COVID-19 global pandemic has reset the world, and mandatory policies such as social isolation have restricted people's activities and space [1–3]. In this critical time, Llorente pointed out that social isolation has a direct impact on how we interact [4]. To satisfy the need for social interaction and overcome physical restrictions, information technology provides an opportunity for our generation to help curb these challenges. Although early research indicated that the role of the Internet may interfere with human psychological problems [5,6]. During the COVID-19 pandemic, Internet communication has become increasingly indispensable.

1.2. The impact of increased internet use

Internet infrastructure is vital to the development of a country. According to China's Internet Development Statistics Report, the proportion of Internet users using mobile phones to access the Internet has reached 99.1% [7]. Internet access via smartphones is one of the sources of problem behaviors, especially among young people [8–10].

However, the culprit of problematic internet use (PIU) is not the smartphone itself, but the excessive use of applications installed on the smartphone [11]. Any APPs on a smart phone device can integrate the exchange of instant messages, pictures, videos, games, and voice calls via the Internet [12,13]. Today, social media apps such as Facebook, Instagram, Reddit, and Tik-Tok play an important role as a platform for social behavior [14,15]. In addition, because of the high loyalty of social platforms, various online activities such as games, chat, and creation may also appear on social platforms [16]. During the COVID-19 quarantine period, young people often used social networks to relax, and shopping behaviors also occurred instantaneously, when recommended ads popped up on their social platforms [15]. The use of social media on smartphones today means more complex multitasking behaviors, the results of which require constant attention. In the new information age, this study investigated two types of behaviors: problematic smartphone use (PSU) and problematic social media use (PSMU) within the framework of problematic Internet use (PIU).

During this pandemic, children and adolescents have spent significantly more time surfing the Internet at home as students take classes

remotely [17], resulting in more screen time usage. This habitual situation has increased as people also need to use their smartphones to contact relatives and friends, update epidemic information, and obtain contact tracking information [18]. However, excessive internet usage and extended screen time can adversely affect cognition and development, especially in children, adolescents, and young people [19]. Studies have indicated that if students have a high rate of social media usage, they may use social media as an unhealthy strategy for dealing with negative emotions and daily problems [20].

Contrary to students who have been observed to exhibit a high risk of mental health problems during the school suspension period, school teachers (another potentially vulnerable population) have not been adequately examined. School teachers who partake in online courses spend more time on the Internet than students because they prepare lectures and provide personalized guidance to individual students [21]. Excessive use of virtual video conferencing platforms also leads to a new phenomenon: fatigue, anxiety, or worry [17]. A survey conducted using Facebook and Instagram data of 380 teachers from different schools during COVID-19 revealed that more than 50% of the teachers spend more than four hours on distance learning every day [22]. Teachers did not devote time to this kind of online work prior to the pandemic [23].

Teachers are prone to experience excessive Internet use during the pandemic because, in addition to the requirement of the aforementioned work, they may also want to use the Internet (e.g., smartphones and social media) to maintain awareness regarding the latest developments on the pandemic and to communicate socially, similar to the general adults identified in COVID-19 literature [8,24–26]. Unfortunately, we believe that as teachers excessively use the Internet, their mental health might be negatively affected since problematic Internet use (PIU) is associated with psychological distress [27–29].

Although abundant references support the association between PIU and psychological distress, the results are inconsistent. For example, Coyne et al. conducted an 8-year longitudinal study, and the results indicated that an increase in time spent on social media was not related to an increase in mental health problems [30]. The possible reason for the inconsistent results may be due to confounding variables (e.g., gender, interpersonal relationships, and health status). Among these variables, sleep problems are critical factors that have been identified to be associated with PIU [31] and psychological distress [32]. Rationally, the association between PIU and psychological distress is intensified in people with severe sleep problems. Similarly, this association may also be less notable in people without severe sleep problems. However, this moderating effect should be tested.

Abbreviations: PIU, Problematic Internet use; PSU, Problematic smartphone use; PSMU, Problematic social media use; DASS-21, Depression, Anxiety, and Stress Scale-21; SABAS, Smartphone Application-Based Addiction Scale; BSMAS, Bergen Social Media Addiction Scale; PCL-5, PTSD Checklist for DSM-5; SEM, Structural equation modeling; CFI, Comparative fit index; NNFI, Non-normed fit index; RMSEA, Root mean square error of approximation; SRMR, Standardized root mean square residual.

<https://doi.org/10.1016/j.sleepe.2021.100005>

Received 5 May 2021; Received in revised form 26 August 2021; Accepted 8 September 2021

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1.3. Statement of the problem

As adults, teachers are not restricted from using the Internet for seeking information or entertainment, and this excessive Internet use can easily become PIU. The situation may worsen if school teachers also use the Internet for work purposes. Although previous studies have indicated an association between PIU and psychological distress [27–29,33], few studies have focused on school teachers. Furthermore, a possible moderator for sleep problems has not yet been clarified in the context of school suspension. Before the pandemic, school teachers were prone to mental illness [34]. Considering the nature of teachers' work tasks during the outbreak (e.g., school teachers should devote more time to work), we should examine teachers' mental illness during this difficult time. As such, this study aims to examine the association between PIU, psychological distress, and sleep problems among school teachers. Moreover, the possible moderating effect of sleep problems was examined.

2. Material and methods

2.1. Procedure and participants

A non-probability sampling method with an online survey was conducted between May 25 and June 30, 2020, on school teachers (primary and middle school). Ethics approval for the study was provided by the institutional review board of the Jianxi Psychological Consultant Association (IRB ref: JXSL-2020-J013). The procedure was as follows: (i) we sought help from principals of primary and middle schools in three provinces (Jiangxi, Sichuan, and Shandong) in China; (ii) we provided the online survey's hyperlink to the principals who accepted our invitation; (iii) these principals forwarded the hyperlink to their respective school's teachers. The online survey was voluntary and anonymous. Informed consent was obtained at the beginning of the survey. Finally, 11014 school teachers (primary school = 6921, middle school = 4093) completed the online survey.

2.2. Measures

In this study, to address the COVID-19 circumstances, common mental illnesses (e.g., depression, anxiety, and stress) were used to represent psychological distress; PIU included two types of problematic Internet activities: problematic smartphone use (PSU) and problematic social media use (PSMU). The instruments used in this study are described in detail below.

2.2.1. Psychological distress

The Depression, Anxiety, and Stress Scale-21 (DASS-21), comprised of 21 items evenly divided into three subscales—depression, anxiety, and stress—was used to reflect participants' psychological distress [35]. The items in the DASS-21 were scored on a four-point Likert scale (from 0 to 3), with higher scores indicating higher levels of depression, anxiety, or stress. The DASS-21 has sound psychometric properties in the Chinese version [36,37]. The Cronbach's alpha of the Chinese DASS-21 utilized in this study was excellent: (i) depression: 0.92 on both categories of school teachers; (ii) anxiety: 0.91 on both categories of school teachers; (iii) stress: 0.90 (primary school) and 0.91 (middle school).

2.2.2. Problematic smartphone use

In this study, we used the Smartphone Application-Based Addiction Scale (SABAS) to measure participants' PSU levels, which was developed by Csibi et al. [38] and included six items. A single construct was used in the SABAS: addiction to smartphone use. The items in the SABAS were scored on a six-point Likert scale (from 1 to 6), with higher scores indicating greater PSU. Previous studies have conducted and verified the Chinese version of SABAS [39,40]. The Chinese version of SABAS also has high internal reliability in this study. Cronbach's alpha was 0.88 for primary school teachers, and 0.87 for middle school teachers.

2.2.3. Problematic social media use

The Bergen Social Media Addiction Scale (BSMAS) developed by Andreassen et al. [41] was adopted to measure participants' PSMU. The BSMAS includes six items scored on a five-point Likert scale (from 1 to 6). The results of previous studies have demonstrated that BSMAS has powerful psychometric properties among primary school students in mainland China [40]. Higher scores on the BSMAS indicated a greater risk of social media addiction. The internal reliability of the Chinese version of the BSMAS in this study was satisfactory, and the Cronbach's alpha for both categories of school teachers was 0.87.

2.2.4. Sleep problem

We adopted three items to measure sleep problems. Among these items, two were from the Chinese Post-traumatic stress disorder (PTSD) Checklist for DSM-5 (PCL-5) [42] and one was from the Chinese version of FCV-19S [43,44]. The two items from PCL-5 were: "In the past few months, the severity of the following conditions has bothered you": (i) repeated dreams of disturbing stressful events (0 = not at all, 1 = a little bit, 2 = moderate, 3 = very serious, and 4 = extremely); (ii) difficulty falling asleep or sleeping well (0 = not at all, 1 = a little bit, 2 = moderate, 3 = very serious, and 4 = extremely). The item from FCV-19S was: "I couldn't sleep well because I was worried about being infected by COVID-19" (1 = totally disagree to 5 = completely agree). The contents of these three items all sought to ask the participants about the severity of sleep disturbances; therefore, we summed the score of each item to represent the severity of the sleep problem with higher scores indicating high sleep problems. Cronbach's alpha was 0.65 for both categories of school teachers, meeting an acceptable level.

2.2.5. Demographic information

In addition to the above measures, we also collected demographic information from the participants, including their respective school types, gender, years of work experience, whether they served as a home-teacher, or they had online teaching experience before school suspension.

2.3. Data analysis

Following the testing of the moderating effect (e.g., Schloderer et al. divided their participants into high and low-income groups to test the moderating effect of their socioeconomic status [38]), the two groups showed a statistically significant difference in the scores of sleep problems ($F = 222420.98$, $p < 0.001$), and η^2p was 0.67, indicating a significant effect [45]. As such, our grouping distinguished between those with high and low levels of sleep problems.

In the Results section, we first provide the key characteristics of the demographic variables between the high and low sleep problem groups separately with descriptive statistics [i.e., frequency (percentage)] and a chi-squared test. Second, an independent t -test was used to compare the differences between the high and low sleep problem groups regarding psychological distress, PSU, and PSMU. Third, the Pearson correlation was used to analyze the correlation among the observed variables (i.e., psychological distress, PSU, and PSMU) by high and low sleep problem groups. Finally, a structural equation modeling (SEM) approach was used to evaluate the overall model fit for the high and low sleep groups. Consequently, a multiple-group analysis with SEM was adopted to test the moderating effect of sleep problems on the influence of PSU and PSMU on psychological distress. In the model, PSU and PSMU served as exogenous latent variables, and psychological distress was an endogenous latent variable using the scores of three subscales (i.e., subscales of depression, anxiety, and stress) as respective indicators. Some critical demographic variables were included in the model as control variables: school type, gender, years of work experience, whether they served as a home-teacher, or had online teaching experience before school suspension. A combination of model fit

Table 1
The differences of the demographic variables between high and low sleep groups.

| | n (%) | | χ^2 (p-value) |
|--|--------------------------------|-------------------------------|-----------------------|
| | High sleep problems (n = 4769) | Low sleep problems (n = 6245) | |
| 1. School type; n (%) | | | 9.82 ($p < 0.001$) |
| Primary school (n = 6921) | 2918 (61.19%) | 4003 (64.10%) | |
| Middle school (n = 4093) | 1851 (38.81%) | 2242 (35.90%) | |
| 2. Gender; n (%) | | | 31.53 ($p < 0.001$) |
| Male (n = 4093) | 1499 (31.43%) | 1658 (26.55%) | |
| Female (n = 4093) | 3270 (68.57%) | 4587 (73.45%) | |
| 3. Years of work experience; n (%) | | | 66.20 ($p < 0.001$) |
| Under 5 years | 1088 (22.81%) | 1837 (29.42%) | |
| 6 to 10 years | 814 (17.07%) | 1074 (17.20%) | |
| 11 to 15 years | 670 (14.05%) | 775 (12.41.0%) | |
| 16 to 20 years | 546 (11.45%) | 641 (10.26%) | |
| Over 21 years | 1651 (34.62%) | 1918 (30.71%) | |
| 4. Home-teacher; n (%) | | | 1.70 (0.19) |
| Yes | 2572 (53.93%) | 3290 (52.68%) | |
| No | 2197 (46.07%) | 2955 (47.32%) | |
| 5. Prior online teaching experience; n (%) | | | 0.92 (0.34) |
| Yes | 1248 (26.17%) | 1584 (25.36%) | |
| No | 3521 (73.83%) | 4661 (74.64%) | |

indices was used to evaluate the overall model fit: comparative fit index (CFI), non-normed fit index (NNFI) > 0.90 , root mean square error of approximation (RMSEA) < 0.10 , and standardized root mean square residual (SRMR) < 0.08 [46]. Furthermore, the moderating effect was examined by a chi-square difference test. Specifically, we constrained the coefficient from PSU and PSMU on psychological distress effect as equal across high and low sleep problem groups. When the difference of the value of chi-square from the unconstrained model to constrained model meets the significant level, the moderating effect is considered present.

3. Results

3.1. The differences of the demographic variables between high and low sleep problem groups

Table 1 presents the results of the frequency (percentage) and the chi-squared test for the demographic variables. The results indicate that there are significant differences between the high and low sleep problem groups regarding school type, gender, and years of work experience. Specifically, the proportion of middle school teachers in the high sleep problem group is significantly higher than that of primary school teachers ($\chi^2 = 9.82$, $p < 0.001$), and the proportion of male teachers in the high sleep problem group is significantly higher than that of female teachers ($\chi^2 = 31.53$, $p < 0.001$); those with more than 11 years of work experience have a significantly higher proportion in the high sleep problem group, while those with less than 5 years of work experience have a significantly higher proportion in the low sleep problem group ($\chi^2 = 66.20$, $p < 0.001$). We also identified that the two demographic variables (whether they served as a home-teacher or had online teaching experience before school suspension) had no significant relationship with teachers' sleep problems.

3.2. Differences in psychological distress, PSU, and PSMU among teachers with different levels of sleep problems

The results of the differences in psychological distress, PSU, and PSMU between the high and low sleep problem groups are presented in Table 2. The results indicate that the high sleep problem group has significantly higher values for psychological distress ($t = 51.89$, $p < 0.001$, Cohen's $d = 1.07$), PSU ($t = 33.09$, $p < 0.001$, Cohen's $d = 0.63$), and PSMU ($t = 26.26$, $p < 0.001$, Cohen's $d = 0.51$).

3.3. The Pearson correlation between psychological distress, PSU, and PSMU

Regarding the association between psychological distress, PSU, and PSMU, the results indicate that there are significant correlations between psychological distress and both types of PIU. Pearson's coefficient between psychological distress with PSU in the high sleep problem group was 0.26 ($p < 0.001$) and 0.23 ($p < 0.001$) in the low sleep problem group. Pearson's coefficient between psychological distress with PSMU in the high sleep problem group was 0.24 ($p < 0.001$) and 0.20 ($p < 0.001$), respectively, in the low sleep problem group (See Table 3).

3.4. The results of structural equation modeling and the moderating effect of sleep problem

The results indicate that the model fits well in the high and low sleep problem groups, and the fit indices meet the criterion (see Table 4, Figs. 1, and 2). Specifically, CFI was 0.970 (high sleep problem group) and 0.977 (low sleep problem group); NNFI was 0.960 (high sleep problem group) and 0.969 (low sleep problem group); RMSEA was 0.069 (high sleep problem group) and 0.060 (low sleep problem group); SRMR was 0.048 (high sleep problem group) and 0.034 (low sleep problem group). Moreover, the effect of PSMU on psychological distress (the coefficient in the high sleep problem group was 0.23, $t = 11.22$, $p < 0.001$; the coefficient in the low sleep problem group was 0.18, $t = 9.11$, $p < 0.001$) was higher than that of PSU in both groups (the coefficient in the high sleep problem group was 0.13, $t = 6.23$, $p < 0.001$; the coefficient in the low sleep problem group was 0.14, $t = 7.27$, $p < 0.001$).

Given that the model fits well with the data, we subsequently tested the moderating effect of sleep problems on the relationship between PIU (PSU and PSMU) and psychological distress using multiple-group analysis. Through the model comparison, we identified that the moderating effect of sleep problems only existed in the direct effect of PSMU on psychological distress, and the $\Delta \chi^2 (1)$ was 79.36, meeting the significant level ($p < 0.001$). Particularly, the harm from PSMU on psychological distress was enhanced in the high sleep problem group.

4. Discussion

This study revealed some fundamental results. First, there were varying degrees of differences in sleep problems regarding teachers' school type, gender, and years of work experience. We identified that during the pandemic, male, older teachers (teachers with more teaching experience), and middle school teachers have been under unknown pressures,

Table 2

The differences between high and low sleep problem groups in psychological distress, PSU and PSMU.

| | M (SD) | | t (p-value) |
|------------------------|-------------------------------|------------------------------|-------------------|
| | High sleep problem (n = 4769) | Low sleep problem (n = 6245) | |
| Psychological distress | 12.94 (11.29) | 3.42 (6.57) | 51.89 (p < 0.001) |
| PSU | 3.11 (0.98) | 2.49 (0.98) | 33.09 (p < 0.001) |
| PSMU | 2.47 (0.78) | 2.08 (0.76) | 26.26 (p < 0.001) |

Note: Psychological distress was assessed by the Depression, Anxiety, and Stress Scale-21 (DASS-21); PSU: problematic smartphone use; PSMU: problematic social media use.

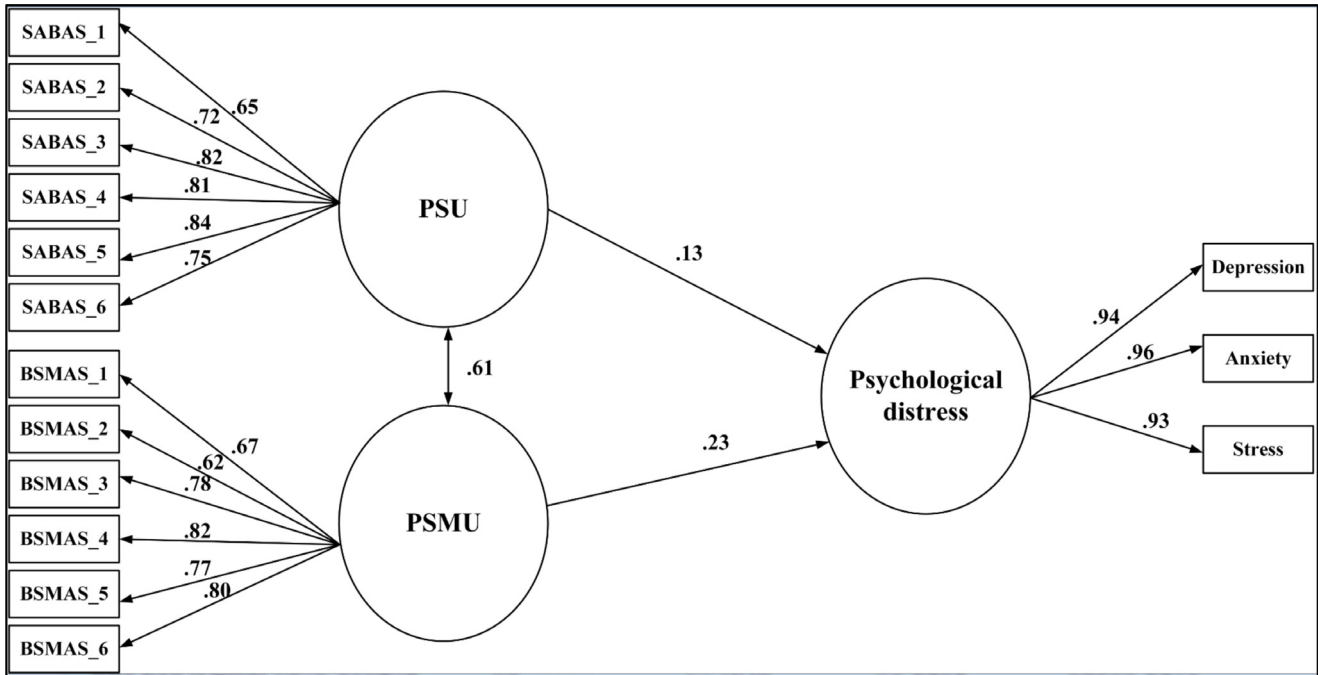


Fig. 1. Model of high sleep problem group.

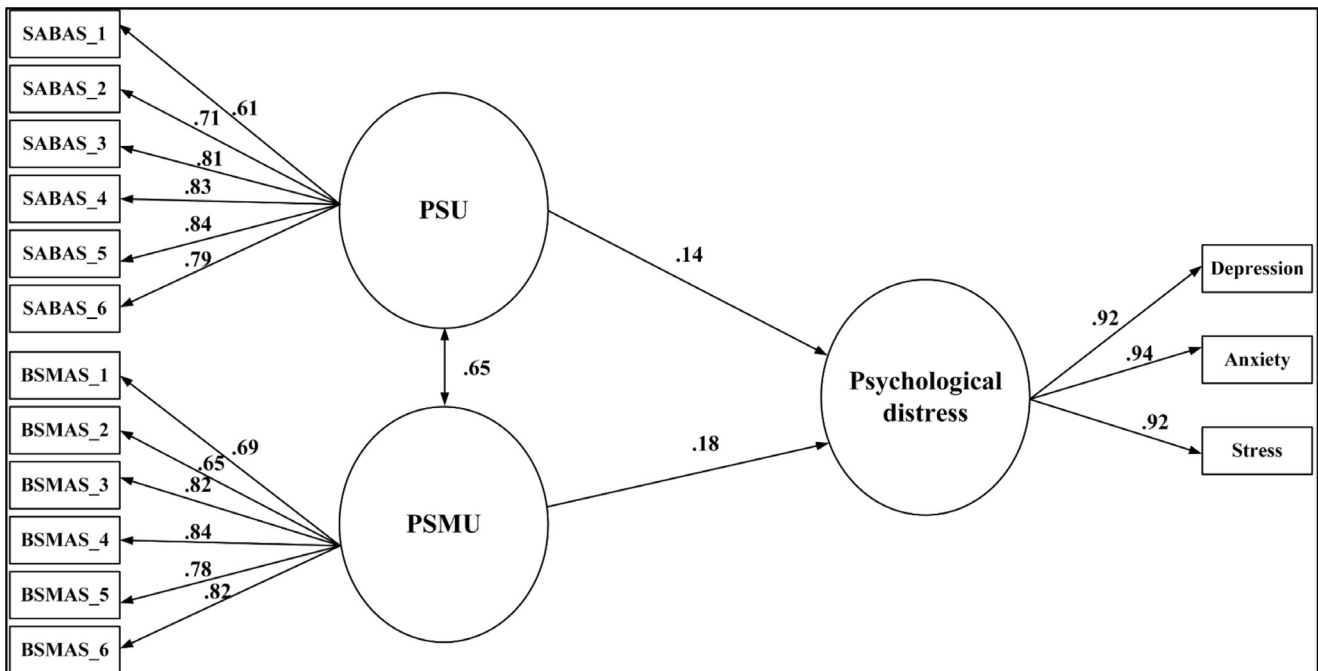


Fig. 2. Model of low sleep problem group.

Table 3
Correlation matrix among psychological distress, PSU, and PSMU.

| High sleep problem group | | | |
|---------------------------|------|------|------|
| | 1 | 2 | 3 |
| 1. Psychological distress | 1.00 | | |
| 2. PSU | 0.26 | 1.00 | |
| 3. PSMU | 0.24 | 0.52 | 1.00 |
| Low sleep problem group | | | |
| | 1 | 2 | 3 |
| 1. Psychological distress | 1.00 | | |
| 2. PSU | 0.23 | 1.00 | |
| 3. PSMU | 0.20 | 0.54 | 1.00 |

Note: Psychological distress was assessed by the Depression, Anxiety, and Stress Scale-21 (DASS-21); PSU: problematic smartphone use; PSMU: problematic social media use. All Pearson correlations meet the significant level ($p < 0.001$).

Table 4
Results of the model fit.

| | χ^2 (df) | CFI | NNFI | RMSEA | SRMR |
|--------------------------------|---------------|-------|-------|-------|-------|
| High sleep problem group | 3460.03 (144) | 0.970 | 0.960 | 0.069 | 0.048 |
| Low sleep problem group | 3394.97 (144) | 0.977 | 0.969 | 0.060 | 0.034 |
| Non-constrained model | 6855.00 (288) | 0.974 | 0.965 | 0.064 | 0.034 |
| Constrained-model ^a | 6852.32 (289) | 0.974 | 0.965 | 0.064 | 0.034 |
| Constrained-model ^b | 6934.36 (289) | 0.973 | 0.965 | 0.065 | 0.035 |

Note: CFI = comparative fit index; NNFI = non-normed fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

^a The direct effect of PSU on psychological distress was constrained equally across the high and low sleep problem groups.

^b The direct effect of PSMU on psychological distress was constrained equally across the high and low sleep problem groups.

which may be affecting their sleep quality. Additionally, we also identified that teachers' sleep problems did not differ depending on whether they served as a home-teacher or had prior online teaching experience. In other words, during the pandemic, teachers' home-teaching and online teaching experiences were not the main reasons for their sleep problems, and other factors must be explored.

Second, the rapid development of Internet media also has a profound impact on interpersonal relationships. The closure of the city has led to more Internet activity. When we desist from physical and social activities to go online, we are more likely to experience PIU. Our findings confirm that there is a significant correlation between the two types of PIU (PSU and PSMU) and psychological distress. This echoes previous research findings [31].

Third, through the multiple-group analysis, we examined the moderating effect and identified that the moderating effect of sleep problems only existed on the direct effect of PSMU. The rapid development of social media has also had a profound impact on interpersonal relationships. At present, we rely heavily on social media to establish connections with family and friends. During the pandemic, people may spend more time on social media to address concerns about COVID-19 and the restrictions of the COVID-19 lockdown. In our findings, the harm from PSMU on psychological distress was enhanced in the high sleep problem group.

5. Conclusion

Our analysis indicates that during the pandemic, the burden of teaching was not directly related to the main cause of psychological distress. Changes in lifestyle during the pandemic mainly depend on time spent

on social media, which may be the real cause of sleep problems and psychological distress.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Revised 26 August 2021