

Social Media Use and Mental Health during the COVID-19 Pandemic: Moderator Role of Disaster Stressor and Mediator Role of Negative Affect

Nan Zhao  and Guangyu Zhou* 

Peking University, Beijing, China

Background: Informed by the differential susceptibility to media effects model (DSMM), the current study aims to investigate associations of COVID-19-related social media use with mental health outcomes and to uncover potential mechanisms underlying the links. **Methods:** A sample of 512 (62.5% women; $M_{\text{age}} = 22.12$ years, $SD = 2.47$) Chinese college students participated in this study from 24 March to 1 April 2020 via online questionnaire. They completed measures of social media use, the COVID-19 stressor, negative affect, secondary traumatic stress (STS), depression, and anxiety as well as covariates. **Results:** As expected, results from regression analyses indicated that a higher level of social media use was associated with worse mental health. More exposure to disaster news via social media was associated with greater depression for participants with high (but not low) levels of the disaster stressor. Moreover, path analysis showed negative affect mediated the relationship of social media use and mental health. **Conclusions:** These findings suggest that the disaster stressor may be a risk factor that amplifies the deleterious impact of social media use on depression. In addition, excessive exposure to disaster on social media may trigger negative affect, which may in turn contribute to mental health problems. Future interventions to improve mental health should consider elements of both disaster stressor and negative affect.

Keywords: COVID-19, disaster stressor, mental health, negative affect, social media use

INTRODUCTION

A newly emerging coronavirus, SARS-CoV-2 (previously known as 2019-nCoV) which can cause coronavirus disease (COVID-19), a severe respiratory illness like SARS and MERS, was first reported in Wuhan, China at the end of

*Address for correspondence: Guangyu Zhou, School of Psychological and Cognitive Sciences and Beijing Key Laboratory of Behavior and Mental Health, Peking University, Beijing 100871, China. Email: gyzhou@pku.edu.cn

2019. The World Health Organization (WHO) initially declared the COVID-19 outbreak a Public Health Emergency of International Concern (PHEIC) and then characterised it as a pandemic. In response to the pandemic, rigorous policies to restrict public movement and large gatherings have been implemented in China, such as extending the Lunar New Year holiday, postponing the spring semester for universities, primary and middle schools and kindergartens (“China Extends Spring Festival Holiday”, 2020). Due to the strict physical distancing measures, people are heavily reliant on media, especially social media (e.g. Weibo and WeChat), to learn the latest news about the pandemic and to maintain connectivity (Limaye et al., 2020).

Disaster Media Exposure and Mental Health

Despite the importance of media in spreading urgent information during times of collective trauma events, numerous studies have suggested that disaster media exposure may evoke poor mental health outcomes. For example, early 9/11- and Iraq War-related television exposure was prospectively associated with increases in posttraumatic stress (PTS) symptoms (Silver et al., 2013). Following the Boston Marathon bombings, six or more daily hours of bombing-related media exposure was associated with higher acute stress symptoms in individuals outside the directly affected community (Holman, Garfin, & Silver, 2014). Among adolescents who did not experience the Sichuan earthquake in 2008, those who were frequently exposed to distressing media images reported a higher risk of posttraumatic stress disorder (PTSD) 6 months later (Yeung et al., 2018). Although the negative impacts of disaster media exposure on a range of psychological outcomes have been demonstrated (see the review by Pfefferbaum et al., 2014), secondary traumatic stress (STS) was not adequately addressed (Ben-Zur, Gil, & Shamshins, 2012; Blanchard et al., 2004). STS refers to PTSD-like symptoms, such as arousal, avoidant behaviors, and intrusive imagery, as a consequence of being indirectly exposed to traumatic events (Branson, 2019; Ludick & Figley, 2017). Given that most people are not infected with SARS-CoV-2, it is critical to consider whether media exposure is associated with STS among the general population. Indeed, Li et al. (2020) found that the general public reported even higher levels of vicarious traumatisation than front-line nurses fighting COVID-19.

Compared with traditional media, social media has played a multitude of positive roles in information exchange during the COVID-19 crisis, including disseminating health-related recommendations, enabling connectivity and psychological first aid (Merchant & Lurie, 2020), showing public attitudes, experience, and perception of the disease as well as sentiment to the government (Zhu, Fu, Grépin, Liang, & Fung, 2020). On the other hand, social media has also fueled the rapid spread of misinformation and rumors, which can create a sense of panic and confusion among the public (Garfin, Silver, & Holman,

2020). However, there has been a dearth of studies focused specifically on social media exposure. Thus, it is still unknown whether and how using social media to access COVID-19 is associated with mental health. In addition, it is necessary to examine the association in young adults, considering that they are more frequent users of social media (China Internet Network Information Center, 2013) and are prone to use social media sources to access disaster-related messages (Piotrowski, 2015).

Theoretical Backdrop

The Differential Susceptibility to Media Effects Model (DSMM; Valkenburg & Peter, 2013) is a well-established integrative model that addresses relationships between media use and health outcomes. According to the DSMM, media usage can influence users' cognitive, emotional, physiological, and behavioral outcomes. Certain individual or social variables moderate the direction or strength of media exposure effects. A group of variables such as current and prior traumatic stress, as well as prior health status, may serve as potential moderators (Houston, Spialek, & First, 2018). Indeed, the relationship between media exposure and worry about the Ebola pandemic was augmented in individuals who reported a higher level of stressful responses to a prior bomb attack (Thompson, Garfin, Holman, & Silver, 2017). In another study, respondents who had previous mental health diagnoses were sensitised to media coverage of disaster events and reported more distress (Thompson, Jones, Holman, & Silver, 2019). To date, however, the conditional effects, such as the moderating role of COVID-19 stress between social media use and mental health, have not been examined in the current pandemic.

Three response states (i.e. cognitive, emotional, and excitative states) have been proposed as mediator mechanisms between media use and health outcomes in the DSMM. Only two studies explicitly examined the mediating process, with acute stress and fear as mediators, respectively (Holman, Garfin, Lubens, & Silver, 2019; Silver et al., 2013). Using longitudinal designs, Silver et al. (2013) concluded that acute stress did not mediate the association between media exposure and physical health, whereas Holman et al. (2019) found that fear of future terrorism significantly mediated the association between media usage and functional impairment. Although underexplored, there has been some evidence suggesting that negative affect might mediate the disaster media effects. For example, watching television news after the 9/11 terrorist attack was related to a range of negative emotions, such as fear, anger, and frustration (Cho et al., 2003). Negative affect, in turn, was often a predisposition to mood disorders (e.g. depression; Mor et al., 2010) and anxiety-related disorders (e.g. PTSD; Weems et al., 2007) in the context of disaster.

The Present Study

The present study aims to investigate whether and how social media exposure to COVID-19 was associated with various mental health outcomes in a sample of Chinese college students. The relationships among social media use, the COVID-19 stressor, negative affect, and mental health, such as STS, depression, and anxiety, were examined. Drawing on the logic of the DSMM and empirical findings on traditional media use, we formulated the following hypotheses:

Hypothesis 1. The more time participants spend on social media accessing content related to COVID-19, the more STS, depression, and anxiety they experience, after controlling for both traditional and internet media usage.

Hypothesis 2. More COVID-19 stressors are associated with greater STS, depression, and anxiety, after controlling for key covariates (e.g. prior collective trauma exposure, health history).

Hypothesis 3. The COVID-19 stressor moderates the relationship between social media use and mental health. Participants with a higher level of COVID-19 stressor report more mental health problems with cumulative daily use of social media, while the association of social media exposure and mental health is attenuated among those with a lower level of COVID-19 stressor.

Hypothesis 4. Negative affect mediates the relationship between social media use and mental health. Specifically, social media use positively correlates with negative affect, which in turn, is positively associated with STS, depression, and anxiety.

METHOD

Procedure and Participants

The present study was approved by the Institutional Review Board at Peking University. To reach college students, the first author posted a recruitment message containing an introduction to the study on a popular social media network in China. During the data collection period, from 24 March to 1 April 2020, the recruitment advertisement was shared and reposted hundreds of times. Viewers who were interested in the study could scan a quick response code directing them to a consent form. Once giving his or her consents, the potential participant was invited to fill in an online survey via www.sojump.com. It takes about 10 minutes to complete the survey.

There were 705 university students who completed the questionnaire. Following the suggestions of Curran (2016), the study adopted various data screening methods to ensure the quality of online data, including response time restriction (ranged from 300s to 2000s, excluded 62 participants), one bogus item (i.e. "I've

never used a mobile phone in my life”, excluded 67 participants), two instructed items (e.g. “Please indicate option [agree] for this question”, excluded 60 participants), and self-report diligence at the end of the survey (i.e. “In your honest opinion, should we use your data in our analyses?”, excluded four participants). The final sample comprised 512 Chinese college students (62.5% women; $M_{\text{age}} = 22.12$ years, range = 18–30 years; for details see Table 1).

Measures

COVID-19 related media use, risk factors (i.e. the COVID-19 stressor, prior collective trauma exposure, and health history), and psychological outcomes (i.e. negative affect, STS, depression and anxiety) were assessed as well as demographics.

Social Media Use. Social media use was adapted from the assessment tool developed by Lin et al. (2016). Participants were required to recall the average number of *total hours per day* they had spent on social media usage during the period of severe epidemic (20 January–17 February 2020, characterised by a sharp increase in accumulated confirmed cases from 258 to 70,635). Specifically, they were asked to estimate the time spent accessing COVID-19-related information through seven widely used social media platforms (i.e. Weibo, Wechat, QQ, Zhihu, Douban, Douyin, and Kuaishou) in China. Responses could range from 0 to 12 hours for each platform. Social media use was computed by summing up the total daily hours, with higher hours indicating more social media use.

COVID-19 Stressor. Adapted from the measurement of SARS-related stressors (Main et al., 2011), a checklist tool with 10 items was used to assess COVID-19 stressors. Participants were asked whether they experienced the lockdown of Wuhan, confirmed or suspected infection, experienced the death of loved ones, witnessed people dying from the infection, worked with infectious patients, volunteered in epidemic prevention and control, and lacked necessities, such as food, face masks, disinfectants, and medical care. Responses were “yes” (coded as 1) or “no” (coded as 0) to each item. The scores of all items were summed to reflect indexes of disaster stressor during the pandemic. The scores ranged from 0 to 10, with a higher score indicating a higher level of disaster stressor.

Negative Affect. The 10-item self-reported Negative Affect (NA) scale of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was used to measure participants’ negative mood in the past two weeks (e.g. “Hostile”, “Afraid”) with 5-point Likert-type graded responses (1 = not at all, 5 = very strongly). Total scores were calculated for analyses, with higher scores indicating more negative affect experienced (Cronbach’s $\alpha = .91$).

TABLE 1
 Characteristics and Responses of Participants ($N = 512$)

Variables	N (M)	% (SD)
Age	22.12	2.47
Gender (female)	320	62.5
Ethnic (Han)	480	93.8
Average monthly household income		
0–4,999 RMB (under \$707)	115	22.5
5,000–9,999 RMB (\$707–\$1,414)	202	39.5
10,000–14,999 RMB (\$1,415–\$2,123)	84	16.4
>15,000 RMB (\$2,124 or more)	111	21.7
COVID-19 stressor		
Self or a close other confirmed or suspected COVID-19 infection	2	0.4
A close other died from COVID-19	1	0.2
Witnessed people dying from COVID-19	7	1.4
Worked with infectious patients	22	4.3
Volunteered in epidemic prevention and control	77	15.0
Lack of food	43	8.4
Lack of face masks or disinfectants	326	63.7
Lack of medical care	12	2.3
Experienced the lockdown of Wuhan	15	2.9
Stayed alone for a long time due to COVID-19	167	32.6
Prior collective trauma exposure		
Self or a close other seriously injured in 2008 Wenchuan earthquake	9	1.8
Witnessed people dying in 2008 Wenchuan earthquake	17	3.3
Self or a close other seriously ill in 2003 SARS pandemic	18	3.5
Witnessed people dying from SARS	6	1.2
Health history		
Caught a cold since the outbreak of COVID-19	110	21.5
Diagnosed with mental disorder	30	5.9
Social media use (h/day)		
Weibo	1.17	1.15
Wechat	1.48	1.36
QQ	0.42	0.82
Douban	0.11	0.48
Zhihu	0.47	0.74
Douyin	0.34	0.92
Kuaishou	0.07	0.39
Traditional media use (h/day)		
Television	0.70	1.00
Radio	0.19	0.60
Newspaper	0.13	0.46
Online media use (h/day)	0.63	1.03

Secondary Traumatic Stress (STS). STS was measured using the 17-item Secondary Traumatic Stress Scale for Social Media Users (STSS-SM), which was originally developed by Bride, Robinson, Yegidis, and Figley (2004) and

further adapted by Megan (2019) in a sample of social media users. The scale assessed participants' traumatic symptoms such as avoidance, intrusion, and arousal through their experiences on social media with traumatised individuals or traumatic events, using 5-point Likert-type scales (1 = never and 5 = very often). For example, "Reminders of things I've seen on social media upset me". Total scores were calculated to indicate STS level (Cronbach's $\alpha = .93$).

Depression. The nine-item Patient Health Questionnaire depression module (PHQ-9; Kroenke, Spitzer, & Williams, 2001) was used to measure depressive symptoms in 4-point Likert-type graded responses (1 = not at all and 4 = nearly every day). For example, "Little interest or pleasure in doing things". Total scores were calculated to indicate the level of depression (Cronbach's $\alpha = .89$).

Anxiety. The seven-item Generalized Anxiety Disorder Scale (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006) was used to assess anxiety symptoms in 4-point Likert-type graded responses (1 = not at all, 4 = nearly every day). For example, "Not being able to stop or control worrying". Total scores were calculated to indicate the level of anxiety (Cronbach's $\alpha = .91$).

Covariates. *Traditional and online media use* measured the time spent accessing COVID-19-related information through three types of traditional media (i.e. television, radio, newspapers) and online media such as Jinri Toutiao (today's headlines). *Prior collective trauma exposure* evaluated (a) whether participants or their close others were seriously injured, (b) whether participants witnessed others dying in the 2003 SARS epidemic or the 2008 Wenchuan earthquake. Participants who gave at least one "yes" response were coded as 1, otherwise coded as 0. *Health history* was assessed with two items inquiring whether participants had a cold during the COVID-19 pandemic or had a history of mental disorder. Participants who answered at least one "yes" response were coded as 1, otherwise coded as 0. *Demographics* including age, gender, ethnicity, education attainment, and average monthly household income were assessed.

Statistical Analysis

First, social media use, traditional media use, and online media use were transformed with the square-root for normality. Descriptive statistics and partial correlations of study variables were calculated while controlling for demographics. Given significant correlations of prior collective trauma exposure, health history, traditional and online media use with mental health, those variables were regarded as covariates in the following analyses. Harman's one-factor test (Podsakoff & Organ, 1986) was used to detect the possibility of common method bias (CMB). All variables of interest were entered into an exploratory factor analysis

(EFA) and the cumulative variance explained by the first unrotated factor was less than 50 percent (i.e. 31.9%), indicating no serious CMB.

Second, to examine the moderating role of the disaster stressor in the relationship of social media use and mental health, mental health outcomes (i.e. STS, depression, and anxiety) were regressed on social media use, the COVID-19 stressor, and their interaction. Finally, to test the mediating role of negative affect, a path analysis was conducted with social media use, the COVID-19 stressor and the interaction term as predictors, negative affect as the mediator, and mental health as outcomes.

Data analyses were performed in SPSS 25 and Mplus 7.4. Multiple model fit criteria were used with RMSEA values lower than 0.08, CFI and TLI values close to 0.90 or higher indicating acceptability (Muthén & Muthén, 2012). Standardised, unstandardised, and 95% confidence intervals of path coefficients were estimated with 5,000 bootstraps.

RESULTS

Preliminary Analyses

Table 2 displays descriptive statistics and correlations among the study variables. The skewness and kurtosis of all variables were between -2 and $+2$, which demonstrated acceptable univariate normality (Mallery & George, 2003). Among the hypothetical risk factors, the COVID-19 stressor was positively related to negative affect ($r = 0.12$), STS ($r = 0.25$), depression ($r = 0.19$), and anxiety ($r = 0.20$). Health history correlated positively with negative affect ($r = 0.16$), STS ($r = 0.21$), and anxiety ($r = 0.10$), while prior trauma had no significant correlation with mental health. Among COVID-19-related media use, social media use was positively related to negative affect ($r = 0.12$), STS ($r = 0.14$), depression ($r = 0.10$), and anxiety ($r = 0.10$). Online media use positively correlated with STS ($r = 0.10$), while traditional media use had no significant correlations with psychological outcomes.

Regression Analyses

Multiple linear regression results showed that associations of social media use with STS ($\beta = 0.18$, $p < .001$), depression ($\beta = 0.11$, $p = .019$), and anxiety ($\beta = 0.12$, $p = .014$) were significant, suggesting that participants who spent more time on social media reported more mental health problems. The results confirmed Hypothesis 1. Supporting Hypothesis 2, the associations of the COVID-19 stressor and STS ($\beta = 0.20$, $p < .001$), depression ($\beta = 0.18$, $p < .001$), and anxiety ($\beta = 0.18$, $p < .001$) were also significant, such that more exposure to COVID-19 was associated with more mental health problems.

TABLE 2
Descriptive Statistics and Correlations between Study Variables (N = 512)

Variable	1	2	3	4	5	6	7	8	9	10
1. COVID-19 stressor	—									
2. Prior trauma	.21***	—								
3. Health history	.08	-.07	—							
4. Social media use	.08	.03	.00	—						
5. Traditional media use	.09*	.16**	.01	.47***	—					
6. Online media use	.13**	.03	-.01	.46***	.45***	—				
7. Negative affect	.12**	-.05	.16***	.12**	.00	.07	—			
8. STS	.25***	.04	.21***	.14**	.05	.10*	.66***	—		
9. Depression	.19***	-.06	.09	.10*	.00	.07	.63***	.64***	—	
10. Anxiety	.20***	.02	.10*	.10*	.02	.05	.72***	.66***	.79***	—
Range	0–5	0–1	0–1	0–21	0–19	0–8	10–47	17–75	0–36	1–28
M	1.31	0.08	0.25	4.05	1.02	0.63	20.48	38.32	15.85	11.79
SD	0.94	0.28	0.43	3.20	1.72	1.03	7.70	12.33	5.34	4.44
Skewness	0.60	—	—	0.44	0.90	0.83	0.84	0.31	0.81	0.99
Kurtosis	0.47	—	—	1.30	0.54	0.01	0.32	-0.34	0.99	1.25

Note: STS = secondary traumatic stress. All analyses controlled for age, gender, ethnicity, education attainment, and monthly average household income. Social media use, traditional media use, and online media use are square-root transformed for normality, and the skewness and kurtosis after transformation are reported. The skewness and kurtosis of prior trauma and health history were not reported since normality testing is not necessary for binary variables.

**p* < .05;
 ***p* < .01;
 ****p* < .001.

More importantly, the interaction of social media use and the COVID-19 stressor was significantly associated with depression ($\beta = 0.09, p = .043$). However, the associations between the interaction and STS ($\beta = 0.06, p = .139$) and anxiety ($\beta = 0.06, p = .166$) were not significant. Simple slope analysis was conducted to probe the significant interaction (Aiken & West, 1991). As Figure 1 illustrates, at a high level of the COVID-19 stressor (1 SD above the mean), participants with a greater amount of social media use reported a significantly higher level of depression ($b = 1.05, SE = 0.35, 95\% CI [0.36, 1.74]; p = .003$). By contrast, at a low level of COVID-19 stressor (1 SD below the mean), social media use was unrelated to depression ($b = 0.15, SE = 0.33, 95\% CI [-0.48, 0.79]; p = .635$). These results partially confirmed Hypothesis 3.

Path Analyses

To further test the mediating role of negative affect between social media use and mental health (i.e. Hypothesis 4), a path analysis was conducted (see Figure 2), which provided an acceptable fit to the data (CFI = 0.991; TFI = 0.922; RMSEA = 0.077, 90% CI [0.041, 0.118]; $\chi^2(4) = 16.242$). Table 3 displays direct, indirect, and total effects. In general, the model confirmed Hypothesis 4 indicating that social media use was indirectly associated with higher levels of STS ($b = 0.98$, 95% CI [0.32, 1.64]), depression ($b = 0.42$, 95% CI [0.13, 0.70]), and anxiety ($b = 0.41$, 95% CI [0.13, 0.68]) through negative affect. Moreover, the model confirmed the results that the joint influence of social media use and the COVID-19 stressor on depression was significant.

DISCUSSION

The mental health status of the public following the outbreak of COVID-19 is a major issue of concern (Bao, Sun, Meng, Shi, & Lu, 2020). Excessive social

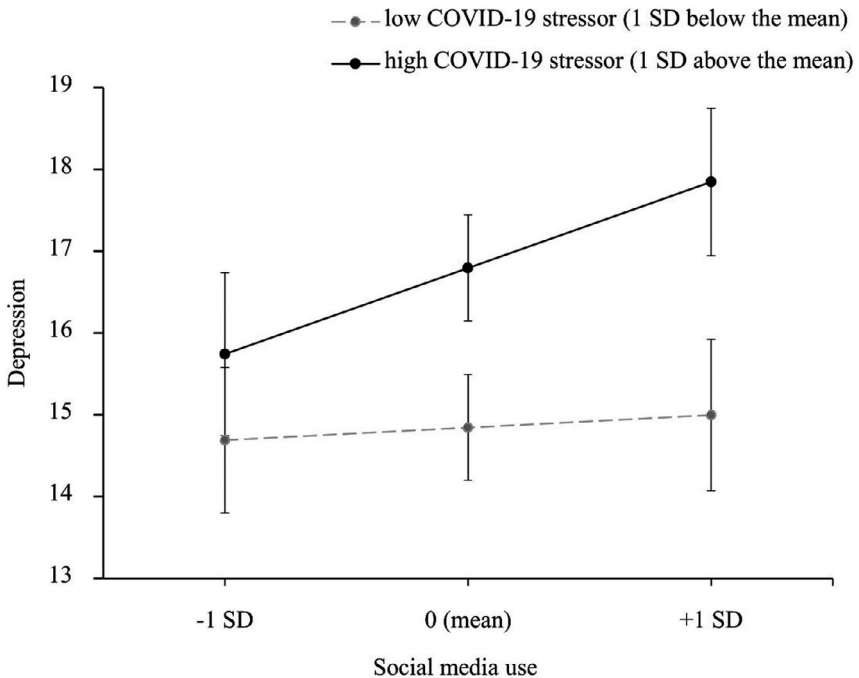


FIGURE 1. Interaction effects of social media use and the COVID-19 stressor on depression. *Note:* Error bars indicate 95% confidence intervals.

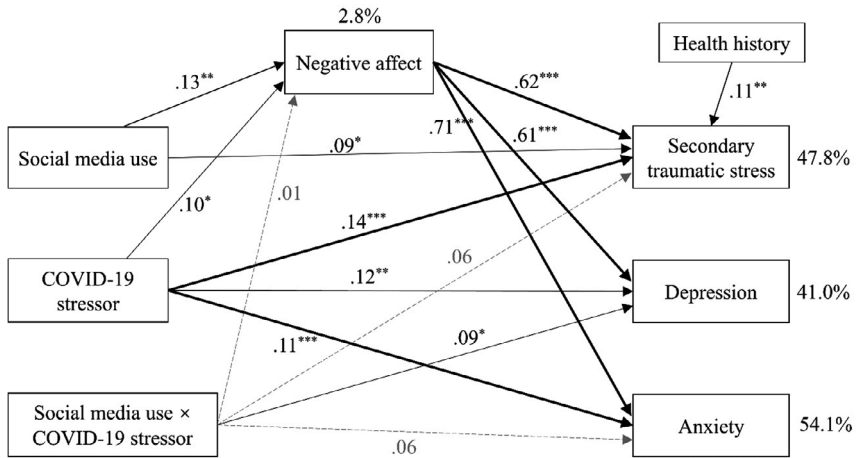


FIGURE 2. Path analysis examining the mediating role of negative affect and the interaction between social media use and the COVID-19 stressor on psychological outcomes simultaneously ($N = 512$). Note: Covariates are prior trauma, health history, traditional and online media use. Nonsignificant paths from covariates to dependent variables are omitted for visual clarity. The values showed are standardised path coefficients. Black solid lines refer to significant paths (bold lines/** $p < .001$; semi-bold lines/** $p < .01$; thin lines/* $p < .05$) and gray dashed lines refer to nonsignificant paths ($p > .05$). Percentages indicate the explained variance of mediator and each dependent variable in the model.

media exposure to this public health crisis might lead to heightened acute stress and long-term psychological distress (Garfin et al., 2020). Our main goal in the present study was to examine the relationships between social media exposure and psychological outcomes during the pandemic. Moreover, we aimed to examine the hypothesised moderator (i.e. the COVID-19 stressor) and mediator (i.e. negative affect) based on the DSMM theory.

Unique Role of Social Media Use in Mental Health

Results showed that disaster-related social media consumption was significantly associated with negative mental health (i.e. STS, depression, and anxiety). The relationship of media exposure and mental health has been evidenced during collective trauma events, such as Ebola (Thompson et al., 2017), the Sichuan earthquake (Yeung et al., 2018), and several terrorist attacks (Holman et al., 2014; Silver et al., 2013; Thompson et al., 2019). More importantly, this study has complemented the existing literature by differentiating media types (i.e. traditional, online vs. social media). Interestingly, our findings suggest that social media use particularly contributed to STS, depression, and anxiety while other

TABLE 3
Direct, Indirect, and Total Effects from Social Media Use and COVID-19 Stressor
to Psychological Outcomes

	β	b	SE	95% CI
Social media use → negative affect → STS				
Direct	0.09*	1.06	0.44	[0.20, 1.93]
Indirect	0.08**	0.98	0.34	[0.32, 1.64]
Total	0.17***	2.04	0.55	[0.96, 3.13]
Social media use → negative affect → depression				
Direct	0.02	0.12	0.21	[-0.28, 0.53]
Indirect	0.08**	0.42	0.14	[0.13, 0.70]
Total	0.10*	0.54	0.25	[0.05, 1.03]
Social media use → negative affect → anxiety				
Direct	0.01	0.06	0.15	[-0.24, 0.35]
Indirect	0.09**	0.41	0.14	[0.13, 0.68]
Total	0.10*	0.46	0.20	[0.06, 0.86]
COVID-19 stressor → negative affect → STS				
Direct	0.14***	1.68	0.41	[0.88, 2.48]
Indirect	0.06*	0.72	0.34	[0.06, 1.39]
Total	0.20***	2.40	0.53	[1.37, 3.44]
COVID-19 stressor → negative affect → depression				
Direct	0.12**	0.65	0.19	[0.27, 1.02]
Indirect	0.06*	0.31	0.14	[0.03, 0.59]
Total	0.18***	0.95	0.24	[0.49, 1.42]
COVID-19 stressor → negative affect → anxiety				
Direct	0.11***	0.49	0.14	[0.22, 0.76]
Indirect	0.07*	0.30	0.14	[0.03, 0.57]
Total	0.18***	0.79	0.20	[0.40, 1.18]

Note: STS = secondary traumatic stress.

* $p < .05$;

** $p < .01$;

*** $p < .001$.

media usages were unrelated to mental health. This pattern is in line with previous findings indicating that frequently social media usage was positively associated with the high odds of anxiety, depression (Gao et al., 2020), and PTS (Goodwin, Palgi, Hamama-Raz, & Ben-Ezra, 2013).

The unique role of social media use in mental health might be explained from the characteristics of social media. During the pandemic, social media has become one of the most important channels to disseminate information with an absolute superiority in speed, reach, and penetration (Merchant & Lurie, 2020). Compared with their use of traditional media, young adults are more likely to use social media sources to attend to disaster-related coverage (Jones, Garfin, Holman, & Silver, 2016). Massive information on social media with various forms (e.g. text, picture, video and live streaming) enables people to stay informed on the latest policies and recommendations regarding COVID-19

prevention, and also to get connected with those who have been directly exposed to the disaster (e.g. infected patients, front-line medical staff; Garfin et al., 2020). Meanwhile, social media has been used to create and share information with personal interpretations, which may lead to the transmission of rumors, conspiracies, or misinformation (Wang, McKee, Torbica, & Stuckler, 2019). Taken together, the indispensability and complexity of social media might amplify the negative psychological consequences of disaster exposure while at the same time covering the effects of traditional media.

Moderator Role of the COVID-19 Stressor

In addition to media exposure, disaster-related stressors have also been considered one of the key predictors of mental health (Paul et al., 2014). The COVID-19 stressor was operationalised as a common stressor that people experienced amid the pandemic in the current study. A higher level of disaster stressor was associated with worse mental health outcomes. The result is consistent with prior studies indicating that individuals who experienced more disaster-related stressors were at higher risk of DSM-IV anxiety-mood disorders (Galea et al., 2007). In addition, social media use was positively related to depression only at a high (but not low) level of the COVID-19 stressor. It suggests that people who experienced a higher level of the stressor had greater vulnerability to depression. It should be noted, however, that the contribution of the interaction term is relatively small.

Individuals who suffered from collective trauma experienced higher levels of physiological arousal and fear, many of whom continued to worry about themselves and their families (Pfefferbaum et al., 1999). It is likely that excessive exposure to social media coverage maintained their heightened reactivity to traumatic events which may in turn, predispose them to develop post-disaster stress. However, it is somewhat surprising that the interaction of social media use and the COVID-19 stressor was only significantly associated with depression, but not STS or anxiety. A possible explanation might be that people who experienced the COVID-19 stressor are faced with real problems such as lacking necessities and experiencing bereavement. Being immersed in social media may not solve the problems but reinforce their feelings of sadness and helplessness. In this sense, depression might be a more common manifestation of distress than other psychological symptoms.

Mediating Role of Negative Affect

Another main finding is that negative affect mediated the relationship between social media use and mental health (i.e. STS, depression, and anxiety). This finding is not only consistent with the theoretical mechanistic pathways proposed by the DSM (Valkenburg & Peter, 2013), but is also in line with prior research

indicating fear as a mediator from exposure to bloody images of a bombing event to future functioning impairment (Holman et al., 2019). It suggests that negative emotional states explain the relationship between exposure to COVID-19 information on social media and negative mental health outcomes.

Exposure to disaster content on social media may be associated with mental health through differential plausible avenues. As stated by Bayer and his colleagues (Bayer, Triêu, & Ellison, 2020), one of the elements of social media is stream (or feeds), which is the aggregated flows of content seen on home pages of social media platforms (e.g. “Hot search” on Weibo; “Moments” on WeChat). The stream can help users gain knowledge of heated issues as well as others’ activities, thoughts, and stories. In the pandemic context, people have a strong desire to comprehend the consequences of the disaster and stream appears to fulfill this desire by leading users to authentic and personal information (e.g. short videos, blogs documenting COVID-19) shared by those directly exposed to COVID-19. This could open doors for emotion contagion because viewers may observe and perceive negative emotions expressed through social media (Kramer, Guillory, & Hancock, 2014). For example, respondents with social media exposure described negative emotions such as sadness, grief, compassion, shock, and numbness in a disaster situation (Neubaum, Rösner, Rosenthal-von der Pütten, & Krämer, 2014). Such empathic responses combined with prolonged exposure to suffering may contribute to the onset of STS (Ludick & Figley, 2017). It is also possible that repeated exposure to heartbreaking news with respect to COVID-19 puts people at risk of depression due to a process of grief rumination (Lenferink, Eisma, de Keijser, & Boelen, 2017). Unlike traditional media on which information is strictly regulated to ensure credibility, social media provides a public space where users can communicate unfiltered information, thus giving rise to rumors (Jones, Thompson, Dunkel Schetter, & Silver, 2017). Coronavirus rumors on social media can greatly exacerbate negative emotions (e.g. panic, fear, and distress), which may in turn induce anxiety symptoms (Dong & Zheng, 2020).

Possible Alternative Explanations for the Findings

Since the findings are largely based on cross-sectional data, the directionality of the associations among social media use, negative affect, and mental health is still not clear. It is possible that individuals living with mental health conditions tend to consume more COVID-19-related information on social media. For example, individuals with major depressive disorder (MDD) did spend more daily hours using the computer compared to healthy controls (de Wit, van Straten, Lamers, Cuijpers, & Penninx, 2011), which may put them at increased risk of news coverage of collective trauma. Another study found that stress responses to past traumatic events predicted increased consumption of media following later collective tragedies (Thompson et al., 2019). Such specific media usage

patterns may lead to subsequent post-disaster distress over time, thereby fueling a vicious cycle. This process also corresponds with what the DSMM proposed as transactional effects that media exposure and health outcomes operate in a feedback loop.

Another possible explanation arises from uncertainty management theory which states that seeking disaster-related information from media is a way of mitigating uncertainty (Lachlan, Spence, & Seeger, 2009). In the case of the September 11 attack, for example, those who experienced a range of negative emotions such as anger, grief, and powerlessness were motivated to learn about the disaster (Boyle et al., 2004). In the context of COVID-19, people tend to perceive the coronavirus as threatening and present feelings of fear and worry. Consequently, these negative emotions may lead to increased use of social media to seek assurance, but may further heighten the risk for mental health disorders.

Implications

Regardless of the direction of association between social media use and mental health, our findings have important implications. From a theoretical perspective, our findings have enriched the DSMM model by identifying negative affect as one mediator as well as the COVID-19 stressor as one moderator. The emotional pathway from social media use to mental health highlights the importance of managing negative emotions such as fear, anger, and sadness when using social media to access information. It is also worth noticing that people experiencing a higher level of the COVID-19 stressor exhibited vulnerability to depression. Together with other dispositional factors such as prior collective trauma and pre-existing mental health conditions, disaster-related stressors serve as a significant moderator of the disaster media effect. Our findings also shed light on strategies of trauma prevention and intervention. It is critical for policymakers, public health agencies, parents, psychologists, and healthcare staff to remain sensitive to the potential negative consequences of ubiquitous social media exposure. The general public, especially those who have been directly or indirectly traumatised by COVID-19, could be advised to avoid excessive social media use and learn effective emotion regulation strategies (e.g. reappraisal) to reduce negative emotions induced by news coverage.

Limitations

There are several limitations to the current study. Participants were fully recruited via social media and those who did not use any type of social media may not be included in the study, posing a potential threat to representativeness of the sample. Time on social media to access COVID-19 information in a specified period was recalled, which was prone to recall bias. To increase memory accuracy, a brief timeline with major events was provided to remind participants

of the time period. We used self-report measures of social media use, which could be improved by ongoing media diaries or objective data accessed from media platforms. Face-to-face clinical interviews rather than self-report measures of psychological symptoms could also be an alternative.

The time lag between the measurement of social media use and negative affect is not short enough to assess the immediate responses to disaster messages, given that emotional response was characterised as a state-like variable in the DSMM (Valkenburg & Peter, 2013). It may be valuable for future studies to use intensive longitudinal measures (e.g. daily diaries or experience sampling) to capture the concurrent variations of emotions and social media use patterns on a daily level (Choi & Toma, 2014; Stieger & Lewetz, 2018). Furthermore, the current study measured negative affect as a general emotional state, making the concept excessively overlap with mental health outcomes (i.e. depression, anxiety, and STS). Future studies are encouraged to measure specific emotional responses to COVID-19, such as fear (Ahorsu et al., 2020), grief (Kristensen, Dyregrov, Dyregrov, & Heir, 2016), and anger (Park, Aldwin, Fenster, & Snyder, 2008).

The current study only tested the potential mediating role of emotional states. Other mediators of disaster media effects, such as cognitive appraisal or excitative responses (Houston et al., 2018), likely exist and should be explored in future research. The study only measured frequency of social media consumption, and did not attempt to disaggregate for media content (e.g. positive vs. negative information; texts, graphics, or videos) and user types (e.g. active vs. passive use). To further investigate how media exposure influences mental health, more detailed assessments on social media use are needed (Hall et al., 2019; Neubaum et al., 2014). Although we have controlled for several potential confounds (i.e. prior collective trauma exposure, mental health, and demographics), it is still possible that other unmeasured, individual characteristics (e.g. neuroticism, specific mental health diagnoses) might exist and explain the observed associations. Lastly, it should be acknowledged that the cross-sectional design limits causal inferences, although a theoretical case for the direction of causality can be made based on previous literature. Longitudinal studies with large time lags are imperative to clarify the psychological processes that may be affected by social media exposure as well as to track mental health symptoms over time following COVID-19.

REFERENCES

- Ahorsu, D.K., Lin, C.-Y., Imani, V., Saffari, M., Griffiths, M.D., & Pakpour, A.H. (2020). The Fear of COVID-19 Scale: Development and initial validation. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00270-8>.
- Aiken, L.S., & West, S.G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage.

- Bao, Y., Sun, Y., Meng, S., Shi, J., & Lu, L. (2020). 2019-nCoV epidemic: Address mental health care to empower society. *The Lancet*, 395(10224), e37–e38.
- Bayer, J.B., Triêu, P., & Ellison, N.B. (2020). Social media elements, ecologies, and effects. *Annual Review of Psychology*, 71(1), 471–497.
- Ben-Zur, H., Gil, S., & Shamshins, Y. (2012). The relationship between exposure to terror through the media, coping strategies and resources, and distress and secondary traumatization. *International Journal of Stress Management*, 19(2), 132–150.
- Blanchard, E.B., Kuhn, E., Rowell, D.L., Hickling, E.J., Wittrock, D., Rogers, R.L., . . . Steckler, D.C. (2004). Studies of the vicarious traumatization of college students by the September 11th attacks: Effects of proximity, exposure and connectedness. *Behaviour Research and Therapy*, 42(2), 191–205.
- Boyle, M.P., Schmierbach, M., Armstrong, C.L., McLeod, D.M., Shah, D.V., & Pan, Z. (2004). Information seeking and emotional reactions to the September 11 terrorist attacks. *Journalism & Mass Communication Quarterly*, 81(1), 155–167.
- Branson, D.C. (2019). Vicarious trauma, themes in research, and terminology: A review of literature. *Traumatology*, 25(1), 2–10.
- Bride, B.E., Robinson, M.M., Yegidis, B., & Figley, C.R. (2004). Development and validation of the secondary traumatic stress scale. *Research on Social Work Practice*, 14(1), 27–35.
- China Extends Spring Festival Holiday (2020). China extends Spring Festival holiday to contain coronavirus outbreak. The State Council of the People's Republic of China. Retrieved from: http://english.www.gov.cn/policies/latestreleases/202001/27/content_WS5e2e34e4c6d019625c603f9b.html
- China Internet Network Information Center (2013). The 32nd China Internet Development Statistics Report. Retrieved from: http://www.cnnic.cn/hlwxzbyj/hlwzxbg/hlwjtjbg/201307/t20130717_40664.htm Accessed 2013 Jul 27.
- Cho, J., Boyle, M.P., Keum, H., Shevy, M.D., McLeod, D.M., Shah, D.V., & Pan, Z. (2003). Media, terrorism, and emotionality: Emotional differences in media content and public reactions to the September 11th terrorist attacks. *Journal of Broadcasting & Electronic Media*, 47(3), 309–327.
- Choi, M., & Toma, C.L. (2014). Social sharing through interpersonal media: Patterns and effects on emotional well-being. *Computers in Human Behavior*, 36, 530–541. <http://dx.doi.org/10.1016/j.chb.2014.04.026>
- Curran, P.G. (2016). Methods for the detection of carelessly invalid responses in survey data. *Journal of Experimental Social Psychology*, 66, 4–19.
- de Wit, L.M., van Straten, A., Lamers-Winkelmann, F., Cuijpers, P., & Penninx, B.W.J.H. (2011). Are sedentary television watching and computer use behaviors associated with anxiety and depressive disorders? *Psychiatry Research*, 186(2–3), 239–243.
- Dong, M., & Zheng, J. (2020). Letter to the editor: Headline stress disorder caused by Netnews during the outbreak of COVID-19. *Health Expectations*, 23(2), 259–260.
- Galea, S., Brewin, C.R., Gruber, M., Jones, R.T., King, D.W., King, L.A., . . . Kessler, R.C. (2007). Exposure to hurricane-related stressors and mental illness after Hurricane Katrina. *Archives of General Psychiatry*, 64(12), 1427–1434.
- Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., . . . Dai, J. (2020). Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One*, 15(4), e0231924.

- Garfin, D.R., Silver, R.C., & Holman, E.A. (2020). The novel coronavirus (COVID-2019) outbreak: Amplification of public health consequences by media exposure. *Health Psychology, 39*(5), 355–357.
- Goodwin, R., Palgi, Y., Hamama-Raz, Y., & Ben-Ezra, M. (2013). In the eye of the storm or the bullseye of the media: Social media use during Hurricane Sandy as a predictor of post-traumatic stress. *Journal of Psychiatric Research, 47*(8), 1099–1100.
- Hall, B.J., Xiong, Y.X., Yip, P.S.Y., Lao, C.K., Shi, W., Sou, E.K.L., . . . Lam, A.I.F. (2019). The association between disaster exposure and media use on post-traumatic stress disorder following Typhoon Hato in Macao, China. *European Journal of Psychotraumatology, 10*(1), 1558709.
- Holman, E.A., Garfin, D.R., Lubens, P., & Silver, R.C. (2019). Media exposure to collective trauma, mental health, and functioning: Does it matter what you see? *Clinical Psychological Science, 8*(1), 111–124.
- Holman, E.A., Garfin, D.R., & Silver, R.C. (2014). Media's role in broadcasting acute stress following the Boston Marathon bombings. *Proceedings of the National Academy of Sciences of the United States of America, 111*(1), 93–98.
- Houston, J.B., Spialek, M.L., & First, J. (2018). Disaster media effects: A systematic review and synthesis based on the differential susceptibility to media effects model. *Journal of Communication, 68*(4), 734–757.
- Jones, N.M., Garfin, D.R., Holman, E.A., & Silver, R.C. (2016). Media use and exposure to graphic content in the week following the Boston Marathon bombings. *American Journal of Community Psychology, 58*(1–2), 47–59.
- Jones, N.M., Thompson, R.R., Dunkel Schetter, C., & Silver, R.C. (2017). Distress and rumor exposure on social media during a campus lockdown. *Proceedings of the National Academy of Sciences of the United States of America, 114*(44), 11663–11668.
- Kramer, A.D.I., Guillory, J.E., & Hancock, J.T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences of the United States of America, 111*(24), 8788–8790. <https://doi.org/10.1073/pnas.1320040111>
- Kristensen, P., Dyregrov, K., Dyregrov, A., & Heir, T. (2016). Media exposure and prolonged grief: A study of bereaved parents and siblings after the 2011 Utøya Island terror attack. *Psychological Trauma: Theory, Research, Practice, and Policy, 8*(6), 661–667.
- Kroenke, K., Spitzer, R.L., & Williams, J.B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606–613.
- Lachlan, K.A., Spence, P.R., & Seeger, M. (2009). Terrorist attacks and uncertainty reduction: Media use after September 11. *Behavioral Sciences of Terrorism and Political Aggression, 1*(2), 101–110.
- Lenferink, L.I.M., Eisma, M.C., de Keijser, J., & Boelen, P.A. (2017). Grief rumination mediates the association between self-compassion and psychopathology in relatives of missing persons. *European Journal of Psychotraumatology, 8*(6), 1378052.
- Li, Z., Ge, J., Yang, M., Feng, J., Qiao, M., Jiang, R., . . . Yang, C. (2020). Vicarious traumatization in the general public, members, and non-members of medical teams aiding in COVID-19 control. *Brain, Behavior, and Immunity, 159*(20), 916–919.

- Limaye, R.J., Sauer, M., Ali, J., Bernstein, J., Wahl, B., Barnhill, A., & Labrique, A. (2020). Building trust while influencing online COVID-19 content in the social media world. *The Lancet Digital Health*, 2(6), e277–e278.
- Lin, L.Y., Sidani, J.E., Shensa, A., Radovic, A., Miller, E., Colditz, J.B., . . . Primack, B.A. (2016). Association between social media use and depression among US young adults. *Depression and Anxiety*, 33(4), 323–331.
- Ludick, M., & Figley, C.R. (2017). Toward a mechanism for secondary trauma induction and reduction: Reimagining a theory of secondary traumatic stress. *Traumatology*, 23(1), 112–123.
- Main, A., Zhou, Q., Ma, Y., Luecken, L.J., & Liu, X. (2011). Relations of SARS-related stressors and coping to Chinese college students' psychological adjustment during the 2003 Beijing SARS epidemic. *Journal of Counseling Psychology*, 58(3), 410–423.
- Mallery, P., & George, D. (2003). *SPSS for Windows step by step: A simple guide and reference*. Boston, MA: Allyn & Bacon.
- Megan, N.M. (2019). Development and validation of the Secondary Traumatic Stress Scale in a sample of social media users. *ETD Archive*. 1132. Retrieved from: <https://engagedscholarship.csuohio.edu/etdarchive/1132>
- Merchant, R.M., & Lurie, N. (2020). Social media and emergency preparedness in response to novel coronavirus. *JAMA*, 323(20), 2011–2012.
- Mor, N., Doane, L.D., Adam, E.K., Mineka, S., Zinbarg, R.E., Griffith, J.W., . . . Nazarian, M. (2010). Within-person variations in self-focused attention and negative affect in depression and anxiety: A diary study. *Cognition and Emotion*, 24(1), 48–62.
- Muthén, L.K., & Muthén, B.O. (2012). *MPlus: Statistical analysis with latent variables: User's guide* (7th edn.). Los Angeles, CA: Muthén & Muthén.
- Neubaum, G., Rösner, L., Rosenthal-von der Pütten, A.M., & Krämer, N.C. (2014). Psychosocial functions of social media usage in a disaster situation: A multi-methodological approach. *Computers in Human Behavior*, 34, 28–38.
- Park, C.L., Aldwin, C.M., Fenster, J.R., & Snyder, L.B. (2008). Pathways to posttraumatic growth versus posttraumatic stress: Coping and emotional reactions following the September 11, 2001, terrorist attacks. *American Journal of Orthopsychiatry*, 78(3), 300–312.
- Paul, L.A., Price, M., Gros, D.F., Gros, K.S., McCauley, J.L., Resnick, H.S., . . . Ruggiero, K.J. (2014). The associations between loss and posttraumatic stress and depressive symptoms following Hurricane Ike. *Journal of Clinical Psychology*, 70(4), 322–332.
- Pfefferbaum, B., Newman, E., Nelson, S.D., Nitiéma, P., Pfefferbaum, R.L., & Rahman, A. (2014). Disaster media coverage and psychological outcomes: Descriptive findings in the extant research. *Current Psychiatry Reports*, 16(9), 464.
- Pfefferbaum, B., Nixon, S.J., Tucker, P.M., Tivis, R.D., Moore, V.L., Gurwitsch, R.H., . . . Geis, H.K. (1999). Posttraumatic stress responses in bereaved children after the Oklahoma city bombing. *Journal of the American Academy of Child & Adolescent Psychiatry*, 38(11), 1372–1379.
- Piotrowski, C. (2015). Mass media use by college students during hurricane threat. *College Student Journal*, 49(1), 13–16.
- Podsakoff, P.M., & Organ, D.W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, 12(4), 531–544.

- Silver, R.C., Holman, E.A., Andersen, J.P., Poulin, M., McIntosh, D.N., & Gil-Rivas, V. (2013). Mental- and physical-health effects of acute exposure to media images of the September 11, 2001, attacks and the Iraq War. *Psychological Science, 24*(9), 1623–1634.
- Spitzer, R.L., Kroenke, K., Williams, J.B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine, 166*(10), 1092–1097.
- Stieger, S., & Lewetz, D. (2018). A Week Without Using Social Media: Results from an Ecological Momentary Intervention Study Using Smartphones. *Cyberpsychology, Behavior, and Social Networking, 21*(10), 618–624. <http://dx.doi.org/10.1089/cyber.2018.0070>
- Thompson, R.R., Garfin, D.R., Holman, E.A., & Silver, R.C. (2017). Distress, worry, and functioning following a global health crisis: A national study of Americans' responses to Ebola. *Clinical Psychological Science, 5*(3), 513–521.
- Thompson, R.R., Jones, N.M., Holman, E.A., & Silver, R.C. (2019). Media exposure to mass violence events can fuel a cycle of distress. *Science Advances, 5*(4), eaav3502.
- Valkenburg, P.M., & Peter, J. (2013). The Differential Susceptibility to Media Effects Model. *Journal of Communication, 63*(2), 221–243.
- Wang, Y., McKee, M., Torbica, A., & Stuckler, D. (2019). Systematic literature review on the spread of health-related misinformation on social media. *Social Science & Medicine, 240*, 112552.
- Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070.
- Weems, C.F., Pina, A.A., Costa, N.M., Watts, S.E., Taylor, L.K., & Cannon, M.F. (2007). Predisaster trait anxiety and negative affect predict posttraumatic stress in youths after Hurricane Katrina. *Journal of Consulting and Clinical Psychology, 75*(1), 154–159.
- Yeung, N.C.Y., Lau, J.T.F., Yu, N.X., Zhang, J., Xu, Z., Choi, K.C., . . . Lui, W.W.S. (2018). Media exposure related to the 2008 Sichuan Earthquake predicted probable PTSD among Chinese adolescents in Kunming, China: A longitudinal study. *Psychological Trauma, 10*(2), 253–262.
- Zhu, Y., Fu, K., Grépin, K., Liang, H., & Fung, I. (2020). Limited early warnings and public attention to coronavirus disease 2019 in China, January–February, 2020: A longitudinal cohort of randomly sampled Weibo users. *Disaster Medicine and Public Health Preparedness, 1–4*. <https://doi.org/10.1017/dmp.2020.68>