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Resilience of adolescents, though weakened during pandemic-related lockdown, serves as a protection against depression and sleep problems

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ABSTRACT

Adolescents facing adversities are susceptible to depression and sleep problems. Resilience is an important protective mechanism for coping with adversity. During the COVID-19 pandemic, adolescents faced hardships including being pulled from their schools and being unable to socialize with friends during mandated lockdowns. We had three aims in this study. First, we sought to test whether Chinese adolescents' resilience was strengthened, maintained, or weakened during the COVID-19 lockdown. Second, we sought to test whether adolescents' resilience predicted depressive symptoms and in turn, sleep problems. Third, we sought to examine the role social support may play. In a partially-longitudinal survey study, we demonstrated via a within-subject *t*-test and its Bayesian equivalent that Chinese adolescents' resilience weakened during the lockdown compared with before the pandemic. However, resilience remained an important predictor: A mediation model demonstrated that higher resilience was associated with fewer depressive symptoms, which in turn predicted fewer sleep problems. Moreover, we found that social support moderated this mediation: Strong social support reduced the negative effects of low resilience levels. These results help shed light on the fragility of resilience, its importance for adolescents' mental health when facing adversity, and how we might support adolescents experiencing social distancing mandates or who are otherwise isolated from their peers.

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resilience; adolescents; lockdown; depression; sleep problems; social support

COVID-19 pandemic lockdowns, which physically isolated people from others who do not live in their homes, was implemented as an effective way to control the transmission of COVID-19. However, disease-related lockdowns can lead to negative mental health outcomes. For example, during the Middle East Respiratory Syndrome (MERS) outbreak in Korea, people reported more anxiety symptoms and feelings of anger during isolation than after the release from isolation, even among people who never became infected (Jeong et al., 2016). A recent review (Brooks et al., 2020) found that most studies examining psychological effects during past quarantines reported negative mental health outcomes including

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depressive symptoms. The emerging research on mental health during COVID-19-related lockdowns, such as effects on depressive symptoms and sleep problems, is mirroring the findings from past epidemic isolation implementations (e.g. lockdowns, quarantines) (Caballero-Domínguez et al., 2020; Li et al., 2020; Liang et al., 2020; Zhou et al., 2020).

The negative consequences of isolation on adolescents' mental health, such as on depressive symptoms and sleep quality, might be buffered by an individual's level of resilience – the ability to tolerate adversity (Chatburn et al., 2014; Hjemdal et al., 2011; Levesque, 2011; Quinton et al., 1993; Zolkoski & Bullock, 2012). In addition, external resources – such as social support – may also play a role in adolescents' mental health during a lockdown (Kaynak et al., 2011; Murberg & Bru, 2004; Van Schalkwijk et al., 2015).

Present study

In the present study, we examined the relationships among resilience (before and during the pandemic), depressive symptoms, sleep problems, and social support among Chinese adolescents experiencing a pandemic-related lockdown. We had three main goals for this study. First, we sought to test whether adolescents' resilience changed from before the pandemic to during a pandemic lockdown. Previous research has suggested that adolescents' resilience can be altered (Hodder et al., 2011; Tam et al., 2020). We therefore predicted that adolescents' resilience differ during a pandemic-related lockdown relative to just prior to the pandemic.

Our second goal was to test if resilience predicted downstream effects in adolescents. According to the protective processes model, resilience can reduce the likelihood of negative chain reactions caused by the risk event (Rutter, 1987), including depression and sleep problems (Chatburn et al., 2014; Hjemdal et al., 2011). Therefore, we predicted that adolescents' resilience would negatively predict depressive symptoms and sleep problems during a pandemic when all adolescents are facing challenges arising from social distancing. Specifically, previous research has demonstrated that depression predicts the development and persistence of sleep problems in adolescents (Ford & Kamerow, 1989; Patten et al., 2000); therefore, we predicted that the depressive symptoms would mediate the relationship between resilience and sleep problems.

Our third goal was to examine the role of social support. According to Cohen and Wills (1985), social support has both direct and buffering effects on negative health and well-being outcomes. Therefore, we predicted that social support would moderate the resilience-depressive symptoms-sleep problems mediation.

Materials and methods

Our research questions, hypotheses, and analysis plan were pre-registered on the Open Science Framework (https://osf.io/gfntd).

Participants, context, and procedure

The sample consisted of 257 adolescents (age M = 13.85, SD = 1.29, range = 11–16 years, 124 female) from the same school in Xiamen, Fujian Province, China. This city has a population of 4 million. All students lived in middle-class neighborhoods.

From February 8th to April 20th, 2020, Xiamen was under lockdown – only essential work and necessary shopping were allowed. We collected data between April 9th, 2020 and April 17th, 2020. During this time all students in the sample were attending school from home via remote classes and engaging in mandatory preventative social distancing.

At the time of data collection there had only been 35 confirmed cases in the city (< 0.00001%) and zero COVID-19-related deaths.[1] Thus, while we cannot know for sure that the majority of stress during this time is more associated with social distancing than fearing for one's own wellbeing or the wellbeing of friends and family, knowledge of infections in friends and family was almost certainly not a disturbing factor (c.f. Mazza et al., 2020, where COVID-19 cases were considerably higher).

The study was approved by the Institutional Review Board of Tsinghua University. The purpose of this online study and the voluntary nature of the students' participation were highlighted before the questionnaire. After the online questionnaire, participants were told that school psychologists or teachers were available to provide counseling services if needed. Participants were asked to independently complete the questionnaire without help from their parents.

We sent an invitation to participate in the study to 1,290 students. Of these, 386 responded with parental consent and student assent. We then sent the survey via email to these students and received 283 survey responses. We excluded responses with missing data (9.2%) resulting in the final sample of 257. We had no additional exclusion criteria. Of the 257 participants, 188 participants' resilience was measured before the pandemic in an in-school survey between November 29th, 2019 and December 9th, 2019. Permission to use the measure of resilience before the pandemic in this study was granted from all 188 participants during the collection of the other measures during the pandemic.

Measures

The data analyzed in this report is a subset of a larger dataset collected before and during the pandemic. All measures collected during the pandemic were pre-registered on the Open Science Framework (https://osf.io/ctudz). The results of other parts of the dataset are to be reported elsewhere.

Resilience

Resilience was measured by the Resilience Scale for Chinese Adolescents (RSCA), a 27-item, 5-point Likert scale self-rating measure (e.g. "I am always discouraged by failure.') (Hu & Gan, 2008). It consists of five components: *goal planning*, which addresses individuals' propensity to adhere to goals, make plans, and focus on solving problems that interfere with these goals; *help seeking*, which addresses individuals' propensity to find people with whom they can talk about their problems; *family support*, which addresses an individual's perception of respect, encouragement, and support from family members; *affect control*, which addresses individuals' ability to moderate their emotions when facing failure and other adversities; and *positive thinking*, which addresses individuals' propensity to focus on the potential benefits from facing adversities. The total score was the sum of all items. Higher scores represent higher levels of resilience. In this study, the internal reliabilities both before and during the pandemic were excellent: both αs = .90.

Depressive symptoms

Adolescents' depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale for Children (CES-DC) (Fendrich et al., 1990; Chinese version: Li et al., 2010), which consists of 20 standardized items to assess frequency of emotional, cognitive, and behavior-related symptoms of depression in the past week (e.g. 'I was bothered by things that usually don't bother me.' Higher CES-DC scores represent increased levels of depressive symptoms. Good reliability and construct validity have been found in a Chinese population (Li et al., 2010). In this study, the internal reliability was excellent (α = .93).

Sleep problems

Sleep problems were measured by the Pittsburg Sleep Quality Index (PSQI), which asks participants to report sleep habits in the past month and measures seven components of sleep quality: *subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction* (Buysse et al., 1989; Chinese version: Liu et al., 1996). The global sleep quality index was the sum, with higher scores representing more severe sleep problems. In this study, the internal reliability of the seven components was acceptable (α = .74).

Social support

Social support was measured by the Multidimensional Scale of Perceived Social Support Scale (MSPSS), which measures three sources of social support: friends, families and significant others on a 7-point Likert scale (e.g. 'I have friends with whom I can share joys and sorrows'.) (Zimet et al., 1988; Chinese version: Wang et al., 2017). In this study, the internal reliability was excellent (α = .94).

Data analyses

Descriptive statistics and correlations of all study variables were calculated. Pearson correlations and paired-samples *t*-tests were conducted to check the consistency of resilience before and during the pandemic (N = 188). We also report Bayes Factor (BF) in support of the alternative hypotheses using JASP (JASP Team, 2021). All non-Bayesian statistical analyses were conducted using SPSS24. Statistical significance was defined as a two-tailed *p*-value of < .05. All models were controlled for covariates of age and gender and the predictors were centered on the mean.

The mediation and moderated mediation models for participants who participated in the study during the pandemic (N = 257) were analyzed using the PROCESS macro for SPSS (Hayes, 2013). The bias-corrected 95% confidence interval (CI) was calculated with 10,000 bootstrap samples. First, we tested whether the association between resilience and sleep problems was mediated by depressive symptoms (see left panel of Figure 1). If the 95% confidence interval of the indirect effect did not contain 0, it indicates the mediating effect is significant. Next, we examined moderated mediation, that is, whether social

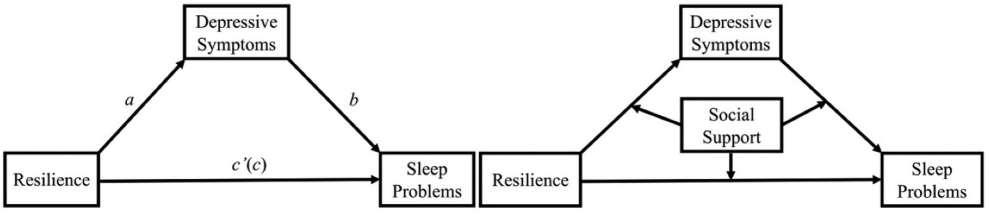


Figure 1. Left panel: schematic model of depressive symptoms as the mediator between resilience and sleep problems (Model 4 in PROCESS). Right panel: schematic model of social support as a moderator of the mediation model (Model 59 in PROCESS).

support moderated the direct or indirect effects of resilience on sleep problems (see right panel of Figure 1). If the 95% confidence interval of the interaction does not contain 0, a significant moderated mediation effect is established.

Results

Correlation of resilience before and during the pandemic

Resilience scores before and during the pandemic were correlated, $r(188) = .46$, $p < .001$. The moderate strength of the correlation suggests the reliability of the measure was influenced by the lockdown.

Differences in resilience before and during the pandemic

A paired-samples *t*-test was conducted to test the difference in resilience before and during the pandemic. In line with our hypothesis that resilience would be altered, we found that resilience during the pandemic ($M = 93.12$, $SD = 10.37$) was lower than before the pandemic, $M = 100.26$, $SD = 17.68$, $t(187) = -6.15$, $p < .001$, $d = -0.45$. See Figure 2.

We explored the change of each component of the resilience measure. With the exception of the *family support* component, which slightly increased during the pandemic compared with before the pandemic, $t(187) = 2.61$, $p = .010$, $d = 0.19$, all other components of resilience decreased significantly. See Table 1.

Descriptive statistics and correlations

Descriptive statistics and the correlations among the various measures administered are shown in Table 2. We did not find gender differences on any measure. With the exception of age, all measures were significantly correlated with one another. Aligning with our hypotheses, the resilience of adolescents during the pandemic was associated with depressive symptoms and sleep problems.

We also explored whether resilience measured before the pandemic – rather than resilience measured during the lockdown – yielded similar associations with depressive symptoms and sleep problems experienced during the lockdown. See Table 2. (Of the 188

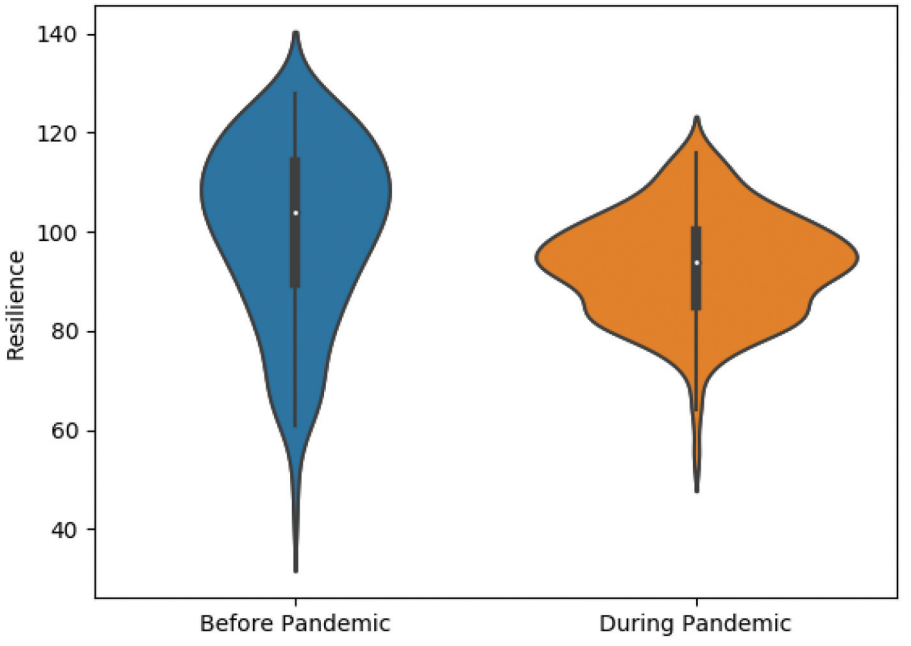


Figure 2. Resilience of adolescents before and during the pandemic.

Table 1. Comparisons for components of and total resilience before and during the pandemic.

	Before pandemic	During pandemic	*t*	Cohen's *d*	Bayes factor
Goal planning	19.95 ± 4.48	18.52 ± 3.73	−4.35***	−0.32	589.95
Help seeking	22.31 ± 6.38	18.90 ± 2.70	−7.64***	−0.56	$> 10^9$
Family support	19.44 ± 2.88	20.18 ± 3.53	2.61*	0.19	2.18
Affect control	21.97 ± 6.19	19.80 ± 2.74	−4.88***	−0.36	5175.15
Positive thinking	16.58 ± 3.69	15.72 ± 2.68	−3.31**	−0.24	15.41
Total resilience	100.26 ± 17.68	93.12 ± 10.37	−6.15***	−0.45	$> 10^6$

*$p < .05$, ** $p < .01$, ***$p < .001$.

participants who provided pre- and during pandemic measures of resilience, 18 had missing scores on the Pittsburgh Sleep Quality Index and were excluded from this analysis.)

Mediation analyses

The results of the mediation analysis demonstrated that the total effect of resilience on sleep problems was significant, $B = -.10$, $p < .001$. The significant coefficient of path a ($B = -.61$, $p < .001$) and path b ($B = .21$, $p < .001$) indicated a negative association between resilience and depressive symptoms, and a positive association between depressive symptoms and sleep problems. Further, the point estimate of the indirect effect (path $a \times b$) between resilience and sleep problems through depressive symptoms was −.13 ($SE = .02$), and the 95% bias-corrected bootstrap confidence interval was −.16 to −.10, which indicated that the indirect effect of resilience on sleep problems was statistically significant. In addition, the direct effect of resilience on sleep problems after including

Table 2. Means and standard deviations for and correlations between age, resilience, depressive symptoms, sleep problems, and social support.

	Mean ± SD	1	2	3	4	5
(1) Age	13.85 ± 1.29	–	−.13	.08	−.05	−.07
(2) Resilience	92.49 ± 10.33	−.09	–	−.37***	−.18*	.36***
(3) Depressive symptoms	15.34 ± 11.59	.09	−.55***	–	.65***	−.50***
(4) Sleep problems	5.01 ± 3.32	.03	−.31***	.68***	–	−.32***
(5) Social support	63.23 ± 14.47	−.04	.69***	−.60***	−.41***	–

Correlations between resilience and other measures during the lockdown are shown below the diagonal. Correlations between resilience before the pandemic and other measures during the lockdown are shown above the diagonal. Means and standard deviations for resilience are those measured during the pandemic.
*$p < .05$, ***$p < .001$.

depressive symptoms as a mediator was no longer significant (path c' = −.03, p = .109, 95% CI = [−.01, .06]), indicating that depressive symptoms fully mediated the relationship between resilience and sleep problems.

We also explored whether resilience measured before the pandemic rather than the measure during the lockdown yielded similar results. We found that pre-pandemic resilience also significantly predicted depressive symptoms and sleep problems during the lockdown (B = −.25, $p < .001$, and B = −.04, p = .042, respectively). Additionally, the pattern of the mediating effect of depressive symptoms held, though with a weaker effect (B = −.05, SE = .01, 95% CI = [−.07, −.03]). See Table S1.

Moderated mediation analyses

According to our hypotheses, social support may function as a moderator between resilience and sleep problems either directly or by interacting with another path in the model. Social support moderated the effect of resilience during the pandemic on depressive symptoms, B = .01, p = .001, 95% CI = [.004, .02]. However, social support did not moderate the relationship between resilience and sleep problems, B = −.001, p = .550, 95% CI = [−.003, .001], or the relationship between depressive symptoms and sleep problems, B = .002, p = .086, 95% CI = [−.000, .003]). Table 3 and Figure 3 show the results of the moderated mediation model with the two null paths removed. See Table S2 for the full moderated mediation model.

Figure 4 reflects how the influence of resilience on depressive symptoms was moderated by social support. When social support was weak, lower levels of resilience was associated with more depressive symptoms. In contrast when social support was strong, depressive symptoms remained low regardless of the one's level of resilience.

One component of the RSCA and one dimension of the MSPSS are both labeled *family support*. Though the items in these two subscales differed, we tested the correlation between these components. They were highly correlated, $r(257)$ = .74, $p < .001$. To ensure that our model was not a statistical artifact, we re-calculated the scores of resilience during the lockdown without the *family support* component and reran the moderated mediation model. The moderation of social support on the relationship between resilience and depressive symptoms remained, B = .01, SE = .004, p = .001, 95% CI = [.01, .02]. See Table S3 for the adjusted results.

Table 3. Results of the moderated mediation model.

Variables		Overall Model Fit			Significance of Regression Coefficient			
Outcome	Predictor	*R*	R^2	*F*	*B*	LLCI	ULCI	*t*
Depressive symptoms	Resilience	.65	.42	36.79***	−.26	−.41	−.12	−3.53***
	Social support				−.32	−.43	−.22	−6.02***
	Resilience × Social support				.01	.004	.02	3.30**
Sleep problems	Resilience	.68	.47	55.03***	.03	−.01	.06	1.61
	Depressive symptoms				.21	.18	.24	13.21***

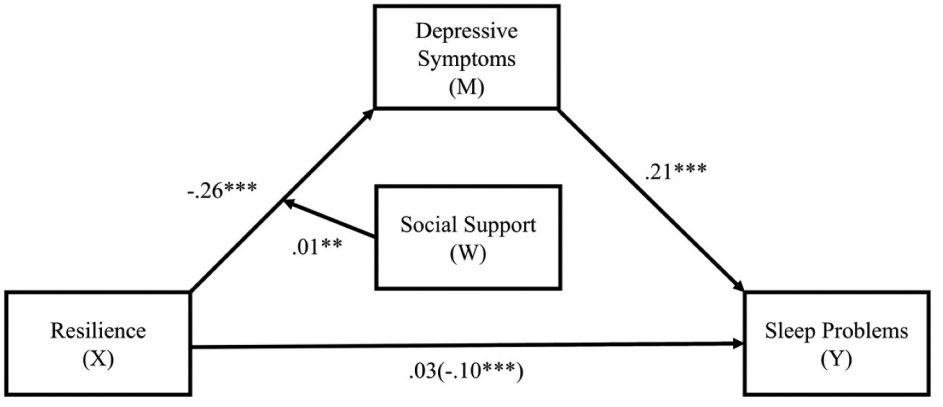
LLCI = lower level confidence interval. ULCI = upper level confidence interval. Age and gender were controlled in the mediation analyses.
$^{**}p < .01$, $^{***}p < .001$.

Discussion

To our knowledge, this is the first longitudinal analysis of adolescents' resilience before and during a pandemic-related lockdown. Previous research has shown that resilience can improve via interventions (e.g. Hodder et al., 2011; Tam et al., 2020), however, it was previously unknown what circumstances might decrease resilience.

During the lockdown, the adolescents in our sample were under mandated social distancing and were attending school from home. Resiliency had strong internal reliability at both time points. However, there was a significant overall drop in scores from before the pandemic to during the pandemic and these two scores were only moderately correlated. This might not be surprising given that the developers of the resilience scale assumed the measure quantified coping processes rather than trait strength (Hu & Gan, 2008). Our result suggest that neither individual differences nor the strength of resilience were stable under the influence of the lockdown.

The finding that resilience was negatively associated with depressive symptoms and sleep problems supports the protective model of resilience (Rutter, 1987). The mediating effect of depressive symptoms also aligns with the assumption that



$^{**}p < .01$, $^{***}p < .001$.

Figure 3. Moderated mediation model results among resilience, depressive symptoms, social support, and sleep problems. **p < .01, ***p < .001.

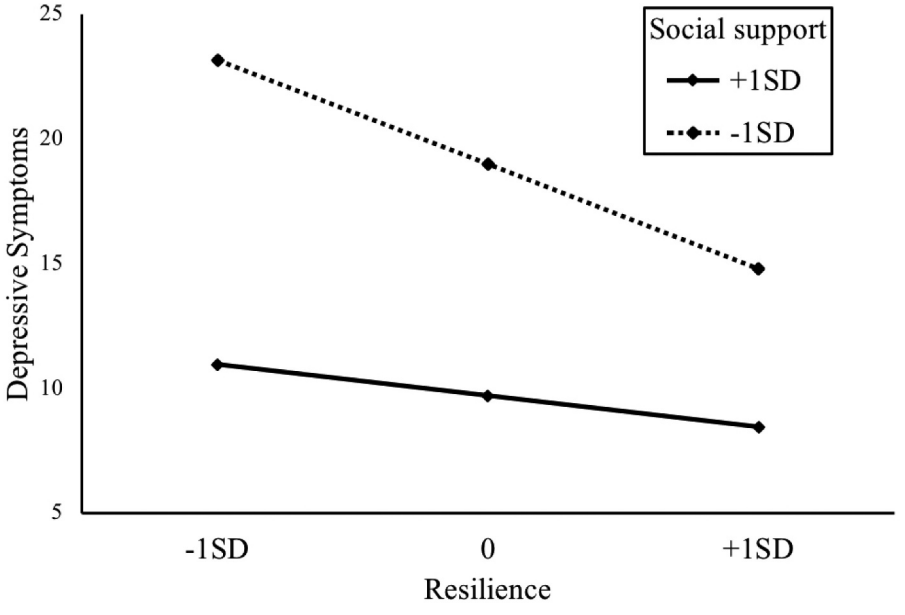


Figure 4. The moderating effect of social support on the relationship between resilience and depressive symptoms.

depressive symptoms might be a precursor to the onset of sleep problems (Patten et al., 2000). The pattern remained when using an earlier pre-pandemic measure of resilience. This suggests that, though resilience was influenced by lockdown, it can still predict future coping processes.

Our findings indicated that social support moderated the effect of resilience on depressive symptoms. For adolescents with low social support, resilience was negatively related to depressive symptoms, whereas for adolescents with high social support, depressive symptoms generally remained low regardless of the adolescent's level of resilience. This finding is consistent with our hypothesis and supports the buffering model of social support, which states social support provides mental resources to cope with depression, such that personal resilience is largely unnecessary when enough social support is offered (Cohen & Wills, 1985). Taken together, our results suggest that, even though resilience might be weakened by the lockdown, external support from friends, families and significant others may compensate for the loss of resilience.

Limitations

Several limitations must be acknowledged. First, the adolescents were from a convenience sample where the researchers had connections and had already collected resilience data just before the pandemic. Second, the web-based and voluntary nature of the study may have introduced selection bias. Third, all students were from middle-class neighborhoods. These study characteristics potentially limit the generalizability of our findings.

Fourth, though this study showed the moderating effects of social support, the effect size was small. Thus, attempts to increase social support to counteract negative impacts from low resilience may only produce limited effects. Fifth, the associations among resilience, depressive symptoms, social support, and sleep problems were found from a cross-sectional dataset, so the findings are not necessarily indicative of causality.

Conclusions

We found that Chinese adolescents' resilience was reduced during a pandemic-related lockdown compared with before the lockdown. We also found that resilience predicted sleep problems and that depressive symptoms fully mediated this relationship. Finally, we found that strong social support moderated the relationship between resilience and depressive symptoms such that social support could compensate for weak resilience.

Our sample was from a city with limited confirmed cases and no pandemic-related deaths but strict lockdown administrative orders. This suggests that our findings are due to psychological factors from the social isolation during the lockdown, rather than illness or immediate concerns for one's health.

Our findings have potential implications for adolescents in future pandemics, future waves of the current pandemic, or, more broadly, any adolescent in social isolation. Our results suggest that adolescents without stable coping processes, especially those without social support, are the most likely to suffer during social isolation. Efforts to identify such adolescents could lead to targeted therapy, resilience training, or efforts to increase social support to improve adolescents' mental health outcomes during times of social isolation.

Note

1. Information from the Municipal Health Commission. Retrieved September 7th, 2021. < https://hfpc.xm.gov.cn/xwzx/tzgg/202004/t20200420_2440260.htm >

Disclosure statement

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Availability of data and material

Our research questions, hypotheses, and analysis plan were pre-registered on the Open Science Framework (https://osf.io/gfntd). The data are publicly available on the Open Science Framework (https://osf.io/c8mxt/).

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