



Relationship between post-traumatic disorder and posttraumatic growth in COVID-19 home-confined adolescents: The moderating role of self-efficacy

Yunchao Jian¹ · Tao Hu¹ · Yu Zong¹ · Wanjie Tang^{2,3,4}

Accepted: 13 November 2021

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract

Although the COVID-19 pandemic has been traumatogenic for some people, posttraumatic growth (PTG) outcomes have also been observed. This study examined the PTG in adolescents and the moderating effect of self-efficacy on post-traumatic stress disorder (PTSD) symptoms and PTG. An online questionnaire was conducted on 2090 adolescent Chinese students to measure COVID-19 related exposure, self-efficacy, PTSD, and PTG. PTG prevalence was found in 20.6% of the sample, with the relationship between PTSD and PTG being found to be a reverse U-shaped curve. Objective exposure factors were found to be closely associated with PTSD symptoms but not with PTG. Similarly, subjective feelings of extreme fear were significantly associated with PTSD symptoms but not with PTG. Self-efficacy was found to be positively correlated with PTG ($r=0.551$) and to moderate the relationship between PTSD and PTG. For those with low self-efficacy, the higher the PTSD, the higher the PTG, and for those with high self-efficacy, the higher the PTSD, the lower the PTG. As an improved sense of self-efficacy in adolescents could promote positive psychological transformations, these results could assist in identifying self-efficacy levels and providing guidance for targeted psychological interventions to promote positive growth.

Keywords PTSD · Adolescent · COVID-19 · Self-efficacy · PTG

Introduction

The Coronavirus pandemic 2019 (COVID-19) was first confirmed in December 2019 in Wuhan, China, after which it spread rapidly across China and then across the world. Due to the unknown transmission routes and the lack of vaccines or effective treatments, there was initial social panic, with many people choosing to isolate at home or stay away from public places. On 21 January, 2020, the

Chinese Government announced social distancing measures, nationwide intercity lockdowns, and the need for citizens to stay at home and avoid unnecessary travel. In mid-to-late March, 2020, the quarantine restrictions began to be lifted across China, with areas that were experiencing severe outbreaks, such as Wuhan, remaining in lockdown until April 8, at which time Chinese schools and universities had been closed for more than two months. However, while effective in preventing the virus spread, these isolation and home quarantine containment measures have been found to have serious psychological consequences (Fekih-Romdhane et al., 2020; Fiorillo et al., 2020; Guessoum et al., 2020; Tang et al., 2020b; Zhou, 2020). For instance, after ten days of COVID-19 quarantine, 7.6% of adult Chinese participants were found to have posttraumatic stress disorder (PTSD) symptoms (Zhang & Ma, 2020), and less than a month after the national lock-down, the overall prevalences for generalized anxiety disorders (GAD), depressive symptoms, and sleep disturbances in adults were found to respectively be as high as 35.1%, 20.1%, and 18.2% (Huang & Zhao, 2020). Around 12.4% of respondents in a large Italian undergraduate sample ($n=20,720$) reported depressive symptoms, and

✉ Wanjie Tang
tangwanjie@scu.edu.cn; tangwanjie2010@gmail.com

¹ Department of Psychology, Chengdu Normal University, Chengdu, China

² Institute of Emergency Management and Post-disaster Reconstruction, No. 24, South Section 1, Yihuan Road, Wuhou District, Chengdu 610065, China

³ Department of Psychiatry, West China Hospital, Sichuan University, Chengdu, China

⁴ Mental Health Center, Sichuan University, No. 24, South Section 1, Yihuan Road, Wuhou District, Chengdu 610065, China

17.6% reported anxiety symptoms (Fiorillo et al., 2020). A recent meta-analysis study revealed that the COVID-19 pandemic had resulted in significant mental health effects in eight countries (Xiong et al., 2020). However, there have been relatively few studies on the psychological impact of the pandemic on adolescents.

Lockdowns and home isolation have been particularly challenging for adolescents as the need for social connections and interactions is critical in this development stage (Fegert et al., 2020). Recent evidence has suggested that home isolation could result in feelings of loneliness and social anxiety in young people, which in turn could make them more vulnerable to psychological distress (Akgül & Ergin, 2021; Hu et al., 2021; Mamun et al., 2021; Racine et al., 2020; Singh et al., 2020; Zhang et al., 2021). A nation-wide Chinese study of 3613 children and adolescents found that 22.28% had suffered some depressive symptoms during the COVID-19 pandemic (Duan et al., 2020), and another study on 8079 Chinese adolescents also reported a high prevalence of depressive (43%), anxiety (37%) and combined depressive anxiety (31%) symptoms (Zhou et al., 2020). A nationwide study in Germany found that the pandemic had also resulted in a significant rise in mental health problems in German children and adolescents (Ravens-Sieberer et al., 2021).

After traumatic events, such as infection fears and infection containment measures, some adolescents have been found to develop symptoms similar to post-traumatic stress disorders (PTSD) (Fitzpatrick et al., 2020b; Tang et al., 2020a). For example, PTSD was observed in around 30% of the children and adolescents who had had to socially isolate with their families in the USA because of their exposure to the H1N1 and SARS-CoV (severe acute respiratory syndrome coronavirus) viruses (Sprang & Silman, 2013).

To date, only a few studies have explored the impact of the COVID-19 pandemic on PTSD symptoms in adolescents (Guessoum et al., 2020; Yue et al., 2020). A recent Chinese study found that 64.5% of adolescents had experienced moderate PTSD symptoms during the COVID-19 outbreak (Li et al., 2020), and other studies have found that the probable adolescent PTSD prevalence was around 21.7% during the outbreak (Zhang et al., 2020) and that quarantine duration, infection fear, being female, and having a family member or friend infected increased the risk of negative psychological outcomes in adults (Brooks et al., 2020). A recent US study found that teenagers were more likely than adults to experience PTSD and depression during outbreaks (Murata et al., 2021). As COVID-19 has continued to spread around the world, it has become necessary to understand the PTSD pandemic effects, such as fear of infection, exposure factors, and social isolation duration, on adolescents.

However, the negative consequences of PTSD can also result in positive outcomes and post traumatic growth

(PTG), which is the positive change experienced as a result of a struggle with trauma or a major life crises (Calhoun & Tedeschi, 2006). PTG is recognized by improved relationships with others, increased personal strength, the identification of new possibilities, positive spiritual change, and an increased appreciation of life. PTG has been observed in people who have experienced a wide range of traumatic events, such as earthquakes (Guo et al., 2018), hurricanes (Lowe et al., 2013), sexual abuse (Kaye-Tzadok & Davidson-Arad, 2016), terrorist attacks (Butler et al., 2005), and SARS (Cheng et al., 2006). However, most COVID-19 research on children and adolescents has focused on the pathological impacts, such as the increased distress and the lower quality of life, rather than the salutogenic impacts.

The relationship between PTSD and PTG is still controversial. Some studies have suggested that there is a negative correlation between PTG and PTSD (Hall et al., 2008), some have found a positive correlation (Jin et al., 2014), and others have found a curvilinear relationship (Kleim & Ehlers, 2009). Therefore, this paper sought to add to this field by exploring the relationship between PTG and PTSD to better understand the current or post-pandemic psychological response mechanisms in home-confined adolescents.

Moderating Role of Self-Efficacy

Psychological resources, such as self-efficacy, have been found to affect individual responses to traumatic events. Self-efficacy has been found to be associated with positive psychological adjustments that protect adolescents from the negative impacts of parental conflict (Brummert Lennings & Bussey, 2017), community violence (Darawshy & Haj-Yahia, 2018), earthquakes (Ho et al., 2017), and terrorist attacks (Benight et al., 2000). Social posttraumatic recovery cognitive theory claims that a strong sense of self efficacy strengthens a person's resilience to adversity (Benight & Bandura, 2004). Because higher self-efficacy was found to be associated with lower PTSD symptoms (Bosmans & Van der Velden, 2015) in a longitudinal study, this paper speculated that self-efficacy could promote PTG and attenuate PTSD symptoms by encouraging favorable appraisals of the COVID-19 threat by encouraging people to make sense of the event, and further surmised that self-efficacy possibly moderated COVID-19 PTSD symptoms and motivated PTG in adolescents.

Therefore, this study investigated the moderating role of self-efficacy on PTSD and PTG and examined the linear and curvilinear associations between PTG and PTSD based on the following hypotheses:

H1: COVID-19 pandemic exposure is positively associated with PTSD and PTG.

H2: Self-efficacy is negatively associated with PTSD and positively associated with PTG.

H3: PTSD is positively associated with PTG.

H4: Self-efficacy moderates the association between PTSD and PTG.

Methods

A cross-sectional online survey was conducted on 2090 participants from February 24 to February 28, 2020 in two medium-risk COVID-19 pandemic areas; Leshan and Jianyang, Sichuan Province; both of which were subject to home-quarantine and social distancing orders from January 21 to March 25, 2020. The participants were students from two senior high schools (12–18 years old), who were invited to participate in the Survey Star Website online survey.

After research consent was given by the schools, the local education Bureau, and from the online consent form signed by the parents and adolescents, the questionnaire was pushed to the parents and students, both of whom were informed that they had the right to terminate the questionnaire at any time. While the questionnaire was anonymous, the student's ID and the parents' last four mobile phone digits were needed for the follow-up evaluation.

This study was reviewed and approved by the Ethics Committee of the University (Blind review requires). This survey was a baseline assessment of the Surveys on the Behavior and Psychological Health Project affected by the COVID-19 (SBPHP_COVID-19).

Measures

Demographic Variables and COVID-19 Related Exposure

A general information questionnaire was used to collect the demographics; age, gender, only child status, and grade level. The COVID-19 related exposure questionnaire was adapted from previous traumatic studies (Roussos et al., 2005; Tang et al., 2018) and included four objective and one subjective COVID-19 exposure related questions, all of which required simple yes or no answers. There were four objective questions: whether the pandemic was serious in their area; whether a friend or relative had been infected with COVID-19; whether they lived in a community in which someone had been infected; and whether they had a friend or relative who had died of COVID-19; and one subjective question: whether had felt extremely fearful during the pandemic.

PTG

PTG was measured using the Chinese version of the Posttraumatic Growth Inventory developed by Tedeschi and Calhoun (Lau et al., 2015; Tedeschi & Calhoun, 1996). This scale has 21 items, each of which is rated on a 6-point scale from 0 = did not experience this change because of the pandemic to 5 = I experienced this change to a very great degree as a result of the pandemic, and five subscales; personal strength, new possibilities, relating to others, appreciation of life, and spiritual change. A total score of 61 or higher (cut-off point = 61) has been found to indicate significant PTG (Rodríguez-Rey et al., 2017). The Chinese version of the Posttraumatic Growth Inventory has been used in previous studies on Chinese adolescents and had shown satisfactory psychometric properties (Tang et al., 2020c). The internal consistency of the present study was found to be excellent (Cronbach's $\alpha = 0.963$).

PTSD

The PTSD symptoms were assessed using the Children's Revised Impact of Event Scale (CRIES) (Smith et al., 2003), which is a widely used, standardized 13-item questionnaire measure of PTSD with established reliability and validity (Tang et al., 2018; Zhang et al., 2015), for which scores of 30 or above are considered to indicate probable PTSD (Perrin et al., 2005). Participants were asked to respond to the scale on a four-point scale ranging from 0 (not at all) to 5 (severely). The Cronbach's α in the current study was 0.894.

Self-Efficacy

A 10-item Chinese version of the self-efficacy scale (Zhang & Schwarzer, 1995) was used to measure the adolescent self-efficacy in coping with the COVID-19 pandemic. Example items were: "It is easy for me to stick to my aims and accomplish my goals during the COVID-19 pandemic"; and "I can solve most problems if I invest the necessary effort even during the COVID-19 pandemic." The participants responded on a 4-point Likert scale from 1 = not at all true to 4 = exactly true, with high scores indicating high self-efficacy. The Cronbach's α for the scale was 0.915 in this study.

Data Analyses

The descriptive information and correlation matrix were calculated using SPSS 22, Kendall's tau-b test was used to calculate the prevalence of PTSD or PTG between the variables, and PROCESS macro was used to analyze the linear and quadratic components of the relationship between PTG and PTSD and the moderating role of self-efficacy between PTSD and PTG (Hayes, 2017).

Results

Descriptive Analysis

As shown in Table 1, the study participants included 786 males (37.6%) and 1304 females (62.4%), 173 (8.3%) of which had positive objective exposure, that is, the pandemic in their area had been/was serious ($n=58$), they had been/were living in an infected community ($n=109$), or a friend or relative had been infected ($n=17$) or died ($n=1$) of COVID-19, and 296 (14.2%) of which had had positive subjective exposure, such as feeling extremely scared during the pandemic ($n=296$).

Suspected PTSD symptoms were found in 6.9% ($n=144$) of the students, with the at-risk of objective exposure students having higher rates of PTSD than the students who had no risk of exposure (12.7% vs. 6.4%). Compared to those that had not felt extreme fear, subjective extreme fear was found to be strongly associated with PTSD symptoms (5.0% vs. 18.6%). The PTG rate was 20.6%, with the proportion being higher in the males than in the females (25.3% vs. 17.8%). The PTSD and PTG variable comparisons are shown in Table 1.

Correlation Analyses

The correlation analyses in Table 2 shows that COVID-19 exposure was positively correlated with PTSD ($r=0.231$), there was a positive association and a slight correlation between PTG and PTSD ($r=0.162$), and self-efficacy was moderately negatively correlated with PTSD ($r=-0.287$) and strongly positively correlated with PTG ($r=0.551$). The linear and quadratic components of the relationship between PTG and PTSD were then examined, from which it was found that the quadratic relationship resulted in a slightly reverse U-shaped curve (Fig. 1) ($R^2=0.029$, $p<0.001$).

Moderation Model

As shown in Table 3, PTSD was found to be positive predictor of PTG ($\beta=0.18$, $P<0.001$), with this effect being moderated by self-efficacy ($\beta=-0.28$, $P<0.001$). For descriptive purposes, the predicted adolescent PTG was separately plotted against the PTSD for low and high self-efficacy (one SD below the mean and one SD above the mean, respectively) (Fig. 2). The simple slope tests revealed that higher levels of PTSD were associated with lower levels of PTG in adolescents with high self-efficacy. However, higher levels

Table 1 PTSD and PTG prevalence stratified by the demographic and exposure variables ($n=2090$)

Variables	PTG (n)	Prevalence (%)	Kendall's tau-b	PTSD (n)	Prevalence (%)	Kendall's tau-b
Total	(n=430)	20.6		(n=144)	6.9	
Gender			-0.091***			-0.024
Male(n=786)	199	25.3		48	6.1	
Female(n=1304)	231	17.8		96	7.4	
Age(yr)			-0.011			-0.040
<15(n=314)	62	19.7		25	8.0	
16(n=691)	149	21.6		34	4.9	
17(n=727)	153	21.0		46	6.3	
18(n=358)	66	18.4		39	10.9	
Grade			0.013			-0.048*
10(n=645)	117	18.1		37	5.7	
11(n=894)	207	23.2		56	6.3	
12(n=551)	106	19.2		51	9.3	
Only-child status			-0.030			0.024
Yes(n=530)	98	18.5		31	5.8	
No(n=1560)	332	21.3		113	7.2	
Objective Exposure			-0.007			-0.069**
Yes(n=173)	34	19.7		22	12.7	
No(n=1917)	396	20.7		122	6.4	
Subjective Exposure			<0.001			0.187***
Yes(n=296)	61	20.6		55	18.6	
No(n=1794)	369	20.6		89	5.0	

* $p<0.05$; *** $p<0.01$; **** $p<0.001$

Abbreviations: PTSD=post-traumatic stress disorder; PTG=post-traumatic growth

Table 2 Correlations for the main study variables (N = 2090)

Variable	1	2	3	4	5	6	7	8	9
1. Gender	1								
2. Age	-0.050	1							
3. Grade	0.002	0.747**	1						
4. Only-child status	-0.090**	-0.011	0.029	1					
5. Objective Exposure	-0.057	0.018	-0.044	-0.059	1				
6. Subjective Exposure	-0.052	0.002	-0.032	-0.041	-0.087	1			
7. Self-efficacy	-0.027	-0.024	-0.031	-0.003	-0.020	-0.103**	1		
8. PTSD	0.113**	0.029	0.054	-0.038	0.078**	-0.269**	0.287**	1	
9. PTG	-0.056	0.004	0.026	-0.037	0.030	0.020	0.551**	0.162**	1

**p < 0.01

Abbreviations: PTSD = post-traumatic stress disorder; PTG = post-traumatic growth

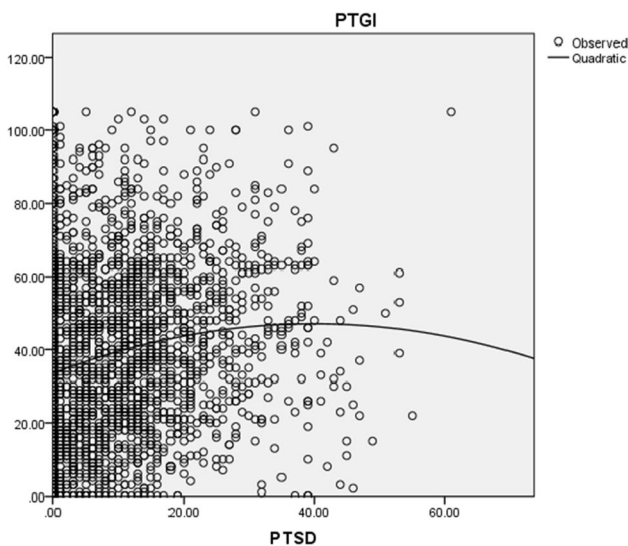


Fig. 1 Quadratic components of the relationship between PTG and PTSD. Abbreviations: PTSD = post-traumatic stress disorder; PTGI = post-traumatic growth index

of PTSD were significantly associated with higher levels of PTG in adolescents with low self-efficacy.

Discussion

To the best of our knowledge, this was the first study to examine: PTSD and PTG in Chinese adolescents during the COVID-19 pandemic; the relationship between PTSD and PTG as a possible consequence of COVID-19 related exposure; and the potential moderating effects of self-efficacy on this relationship. It was found that 20.6% of participants were experiencing PTG and only 6.9% showed PTSD prevalence. The relationship between PTSD and PTG was found to have an inverted U shape and was moderated by

self-efficacy, and COVID-19 related exposure was associated with PTSD but not with PTG.

These findings suggest that both positive and negative psychological outcomes can coexist in adolescents during a pandemic. While the pandemic effects had a negative impact on the adolescents, it also allowed them to experience positive growth. This finding contradicted a recent study that found that 66.9% of college students reported PTG as a result of the COVID-19 pandemic (Chi et al., 2020), and an earlier study in Israel that reported 74% of Israeli adolescents had had some degree of PTG after a traumatic experience (Laufer & Solomon, 2006). These discrepancies may have been because of the different cut-off values, the time after the disaster, education level, or age differences. These results were also supported by a previous study that found that a certain proportion of people had experienced both negative mental health effects and positive outcomes from the SARS outbreak (Lau et al., 2006). Therefore, the major COVID-19 life trauma could have had both negative and positive impacts on adolescents; however, more studies are needed to explore PTG during and/or after the COVID-19 outbreak.

This study found a positive association between trauma and PTSD in the home-confined adolescents, but not between trauma and PTG and also found a dose-response effect, in which the more frequent the objective exposure to the pandemic, the greater the positive association with severe PTSD symptoms. This finding was consistent with previous findings that found that traumatic exposure was strongly associated with PTSD symptoms (Aisenberg et al., 2008; Laufer & Solomon, 2006; Tang et al., 2020b; Yang et al., 2020). The results also appeared to suggest that there was no relationship between objective pandemic exposure and growth, which was in contrast with results from other traumatic events, such as earthquakes (Tang et al., 2020c), domestic abuse (Cobb et al., 2006), or terrorist incidents (Laufer & Solomon, 2006), which suggested that young people may have experienced PTG without having greater

Table 3 Moderating effect of PTSD on PTG via self-efficacy

Predictors	Model 1 (PTG)				Model 2 (PTSD)				Model 3 (PTG)			
	β	se	t	%95CI	β	se	t	%95CI	β	se	t	%95CI
Age	0.015	0.485	0.831	-0.022~0.054	0.027	0.233	1.293	-0.015~0.072	0.005	0.017	0.306	-0.028~0.038
Gender	-0.040	0.945	-2.207*	-0.157~-0.009	0.107	0.454	5.115***	0.136~0.305	-0.135	0.033	-4.072***	-0.201~-0.070
SE	0.550	0.056	30.127***	0.514~0.586	-0.283	0.027	-13.584***	-0.324~-0.242	0.590	0.017	34.135***	-0.556~-0.623
PTSD									0.180	0.021	8.486***	0.139~0.222
PTSD*SE	0.305				0.09				-0.280	0.021	-13.666***	-0.320~-0.240
R ²	0.47											
F	368.14***											

*p < 0.05; **p < 0.01; ***p < 0.001

Abbreviations: PTSD = post-traumatic stress disorder; PTG = post-traumatic growth; SE = self-efficacy

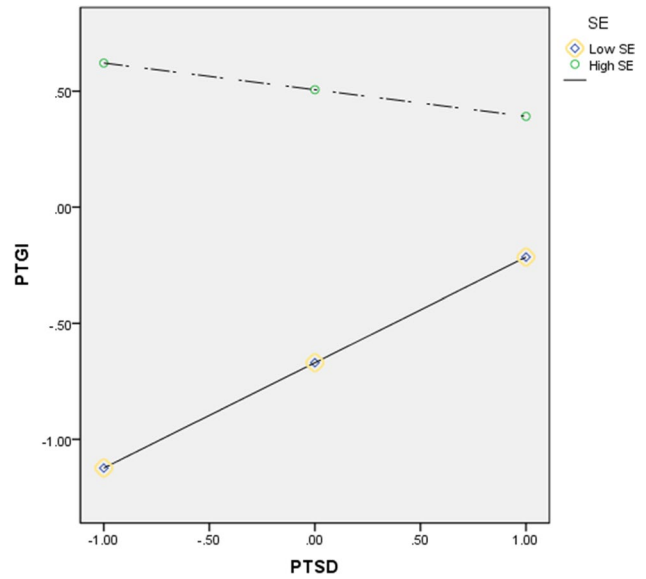


Fig. 2 Moderation effect of self-efficacy between PTSD and PTGI. High and low levels of self-efficacy represent one standard deviation above and below the mean. Abbreviations: PTSD = post-traumatic stress disorder; PTGI = post-traumatic growth index

pandemic exposure. One possible explanation is that unlike other traumatic events, COVID-19 is highly contagious and has several transmission routes that can potentially threaten everyone, even without having a direct exposure to the pandemic. However, more research is needed to confirm this potential mechanism. The results from this study were also in agreement with several recent studies (Bitan et al., 2020; Fitzpatrick et al., 2020a; Haktanir et al., 2020; Ornell et al., 2020; Satici et al., 2020; Tang et al., 2020a) that found subjective extreme fear during the COVID-19 pandemic had had a significant impact on mental health. The possible explanation for this supposition is that fear is closely related to core PTSD symptoms, such as nightmares (Lester, 1969), trauma memory recall (Milad et al., 2008), and negative emotions (Mathews et al., 2003). As fear extinction has been found to be one of the most effective psychological interventions for PTSD (Jovanovic & Ressler, 2010; Milad et al., 2014), it could be surmised that fear is a prominent component in PTSD (Zoellner et al., 2014).

The results also indicated that there was a curvilinear relationship between PTSD and PTG, which was consistent with the positive associations previously found in earthquake survivors (Jin et al., 2014; Zhou & Wu, 2016), youth exposure to terror incidents (Laufer & Solomon, 2006), and assault survivors (Kleim & Ehlers, 2009). One explanation for this may be that PTG generates positive meaning making from the excessive traumatic events that give rise to PTSD symptoms (Calhoun & Tedeschi, 2006). Another possible explanation is that PTSD and PTG are two stress response dimensions, that is, most people

respond to stressful events with a mixture of both resilience and vulnerability (Laufer & Solomon, 2006). This view is in line with a previous study by Linley and Joseph (2004), which concluded that growth and distress should be considered as bivariate independent dimensions rather than two ends of a continuum (Linley & Joseph, 2004).

The results also revealed that self-efficacy was positively associated with PTG and moderated the association between PTSD and PTG; therefore, the adolescents that reported higher levels of self-efficacy were more likely to feel personal growth during the pandemic, which was also consistent with previous research that found that cancer patients with high self-efficacy had higher PTG (Lotfi-Kashani et al., 2014). It was also found that in the adolescents with low self-efficacy, the PTG accorded with the increase in their PTSD symptoms. However, for those had high self-efficacy, the PTG slowly declined as the PTSD symptoms increased. These results indicated that high self-efficacy provides internal and external resources that assist in growth, that is, these adolescents may perceive their pandemic stress as a challenge rather than a threat (Coffman & Gilligan, 2002). People with high self-efficacy have been found to receive greater social support and have greater optimism, both of which can assist in growth (Karademas, 2006). Therefore, for people with high self-efficacy, high PTSD symptoms may partially offset these positive effects; however, this supposition needs to be clarified in future studies.

Bandura et al.'s (1999) social cognitive theory (Bandura, 1999) states that self-efficacy plays a key role in stress reactions and coping quality in threatening situations, and that people with high self-efficacy tend to adopt more positive, problem-oriented coping strategies, but people with low self-efficacy tend to adopt negative or emotional coping strategies, which indicates that enabling high self-efficacy could be a primary vehicle for personal positive change (Benight & Bandura, 2004). Therefore, as a low sense of control can put people at the mercy of the circumstances, they are unable to turn off their perturbing ruminations and are more likely to continue to experience elevated stress from the stressful events. Overall, this supposition indicates that adolescents with higher self-efficacy would be more likely to experience PTG in a pandemic and that the PTSD symptoms in adolescents with low self-efficacy would possibly promote individual thinking, with any growth being consistent with the PTG affective-cognitive processing model, that is, the PTG mostly occurs after a struggle with the PTSD symptoms (Joseph et al., 2012). The results of this study also suggested that different people, such as those with high and low self-efficacy, may have different growth patterns when faced with a pandemic. However, more research is needed to explore the effects of personality differences on PTG and PTSD.

Although this study adds to existing research on the positive aspects of adolescents in a pandemic context, there were several limitations. First, as there were no pre-pandemic data, no comparisons to determine the negative or positive psychological impacts of the pandemic on young people could be made. Second, as the data were cross-sectional, it was difficult to draw any directional or causal conclusions about the self-efficacy and psychological consequences. Therefore, further longitudinal studies are needed to further explore the correlations between PTG, self-efficacy, and PTSD. Third, self-reports can be somewhat biased; however, there is currently no objective method to study people's psychological reactions. Fourth, there were more females than males in the study sample, which may have had some influence on the results. Finally, as social support may influence both positive and negative emotions (Yang et al., 2020), future studies need to include this variable to assess the impacts on the PTG responses to the COVID-19 pandemic.

The results of this study have significant implications for therapists and researchers, and particularly for evidence-based practice. First, this study fills a gap in the field of positive change for a general adolescent population in the COVID-19 context as it elucidated some of the factors that could assist in promoting positive psychological consequences and preventing negative psychological problems in young people under COVID-19 lockdowns. Second, this study provided some evidence that different personality traits could have different post-traumatic reactions to pandemic stress; therefore, more research is needed to explore this post-trauma psychological mechanism. Third, teenagers could benefit from improving their self-efficacy to engender positive psychological change as both positive and negative psychological reactions can coexist and influence each other, especially for people with low self-efficacy. However, people with high self-efficacy, which was found to partially offset PTSD symptoms, are more likely to experience positive change and growth. These results could assist in developing appropriate interventions to promote positive adolescent growth. Both school and parents play important roles in shaping adolescent self-efficacy. Past studies and the current study indicated that individualized education and interventions are important (Jerusalem & Hessling, 2009). For example, individualized task demands, performance feedback, and high transparency of teacher demands and evaluation criteria have been found to benefit student school self-efficacy (Jerusalem & Hessling, 2009). To promote adolescent self-efficacy, parents need to set achievable goals and provide immediate feedback and encouragement (Schunk & Miller, 2002). For example, to develop feeling of capability, parents could encourage their children to try different activities (Schunk & Miller, 2002). A previous systematic review found that interventions that included feedback on past or

others' performances resulted in the highest levels of adolescent self-efficacy (Ashford et al., 2010). Therefore, when adolescents are in home quarantine, communication about the pandemic should be encouraged to assist the children to cope with any emerging mental health problems (Tang et al., 2021). Improving adolescent coping skills and ensuring regular physical activity have also been found to improve adolescent self-efficacy during the COVID-19 pandemic (Liu et al., 2021; Parto & Besharat, 2011).

Acknowledgments The authors wish to thank all study participants and all research collaborators. This research was supported by grants from National Planning Office of Philosophy and Social Science of China (18BSH121).

Author Contributions Yunchao Jian: Writing - original draft, Visualization, Resources, Software, Writing - review & editing; Tao Hu: Writing - original draft, Writing - review & editing, Funding acquisition; Yu Zong: Visualization, Resources, Software, Writing - review & editing; Wanjie Tang: Investigation, Data curation, Funding acquisition, Writing - original draft, Writing - review & editing.

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of Interest The authors state that there is no conflict of interest.

Ethical Approval Ethical approval for the study was granted by the Ethics Committee of the University (Blind review requires) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to Participate All participants were provided with an online informed consent before their participation.

References

- Aisenberg, E., Ayón, C., & Orozco-Figueroa, A. (2008). The role of young adolescents' perception in understanding the severity of exposure to community violence and PTSD. *Journal of Interpersonal Violence, 23*(11), 1555–1578.
- Akgül, G., & Ergin, D. A. (2021). Adolescents' and parents' anxiety during COVID-19: Is there a role of cyberchondriasis and emotion regulation through the internet? *Current Psychology, 1*–10.
- Ashford, S., Edmunds, J., & French, D. P. (2010). What is the best way to change self-efficacy to promote lifestyle and recreational physical activity? A systematic review with meta-analysis. *British Journal of Health Psychology, 15*(2), 265–288.
- Bandura, A. (1999). Social cognitive theory of personality. *Handbook of personality, 2*, 154–196.
- Benight, C. C., & Bandura, A. (2004). Social cognitive theory of post-traumatic recovery: The role of perceived self-efficacy. *Behaviour Research and Therapy, 42*(10), 1129–1148.
- Benight, C. C., Freyaldenhoven, R. W., Hughes, J., Ruiz, J. M., Zoschke, T. A., & Lovallo, W. R. (2000). Coping self-efficacy and psychological distress following the Oklahoma City bombing 1. *Journal of Applied Social Psychology, 30*(7), 1331–1344.
- Bitan, D. T., Grossman-Giron, A., Bloch, Y., Mayer, Y., Shiffman, N., & Mendlovic, S. (2020). Fear of COVID-19 scale: Psychometric characteristics, reliability and validity in the Israeli population. *Psychiatry Research, 289*, 113100.
- Bosmans, M. W., & Van der Velden, P. G. (2015). Longitudinal interplay between posttraumatic stress symptoms and coping self-efficacy: A four-wave prospective study. *Social Science & Medicine, 134*, 23–29.
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *The Lancet, 395*(10227), 912–920.
- Brummert Lennings, H. I., & Bussey, K. (2017). The mediating role of coping self-efficacy beliefs on the relationship between parental conflict and child psychological adjustment. *Social Development, 26*(4), 753–766.
- Butler, L. D., Blasey, C. M., Garlan, R. W., McCaslin, S. E., Azarow, J., Chen, X.-H., Desjardins, J. C., DiMiceli, S., Seagraves, D. A., & Hastings, T. A. (2005). Posttraumatic growth following the terrorist attacks of September 11, 2001: Cognitive, coping, and trauma symptom predictors in an internet convenience sample. *Traumatology, 11*(4), 247–267.
- Calhoun, L. G., & Tedeschi, R. G. (2006). The foundations of post-traumatic growth: An expanded framework.
- Cheng, S. K., Chong, G. H., Chang, S. S., Wong, C. W., Wong, C. S., Wong, M. T., & Wong, K. C. (2006). Adjustment to severe acute respiratory syndrome (SARS): Roles of appraisal and post-traumatic growth. *Psychology and Health, 21*(3), 301–317.
- Chi, X., Becker, B., Yu, Q., Willeit, P., Jiao, C., Huang, L., Hossain, M. M., Grabovac, I., Yeung, A., & Lin, J. (2020). Prevalence and psychosocial correlates of mental health outcomes among chinese college students during the coronavirus disease (covid-19) pandemic. *Frontiers in Psychiatry, 11*, 803.
- Cobb, A. R., Tedeschi, R. G., Calhoun, L. G., & Cann, A. (2006). Correlates of posttraumatic growth in survivors of intimate partner violence. *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies, 19*(6), 895–903.
- Coffman, D. L., & Gilligan, T. D. (2002). Social support, stress, and self-efficacy: Effects on students' satisfaction. *Journal of College Student Retention: Research, Theory & Practice, 4*(1), 53–66.
- Darawshy, N. A.-S., & Haj-Yahia, M. M. (2018). Internalizing and externalizing symptoms among Palestinian adolescents from Israel as consequences of their exposure to community violence: Are they moderated by their self-efficacy and collective efficacy? *Child Abuse & Neglect, 79*, 61–73.
- Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., & Zhu, G. (2020). An investigation of mental health status of children and adolescents in China during the outbreak of COVID-19. *Journal of Affective Disorders, 275*, 112–118.
- Fegert, J. M., Vitiello, B., Plener, P. L., & Clemens, V. (2020). Challenges and burden of the coronavirus 2019 (COVID-19) pandemic for child and adolescent mental health: A narrative review to high-light clinical and research needs in the acute phase and the long return to normality. *Child and Adolescent Psychiatry and Mental Health, 14*, 1–11.
- Fekih-Romdhane, F., Ghrissi, F., Abbassi, B., Cherif, W., & Cheour, M. (2020). Prevalence and predictors of PTSD during the COVID-19 pandemic: Findings from a Tunisian community sample. *Psychiatry Research, 290*, 113131.
- Fiorillo, A., Sampogna, G., Giallonardo, V., Del Vecchio, V., Luciano, M., Albert, U., Carmassi, C., Carrà, G., Cirulli, F., & Dell'Osso, B. (2020). Effects of the lockdown on the mental health of the general population during the COVID-19

- pandemic in Italy: Results from the COMET collaborative network. *European Psychiatry*, 63(1).
- Fitzpatrick, K. M., Harris, C., & Drawve, G. (2020a). Fear of COVID-19 and the mental health consequences in America. *Psychological trauma: theory, research, practice, and policy*, 12(S1), S17.
- Fitzpatrick, K. M., Harris, C., & Drawve, G. (2020b). Fear of COVID-19 and the mental health consequences in America. *Psychological trauma: theory, research, practice, and policy*.
- Guessoum, S. B., Lachal, J., Radjack, R., Carretier, E., Minassian, S., Benoit, L., & Moro, M. R. (2020). Adolescent psychiatric disorders during the COVID-19 pandemic and lockdown. *Psychiatry research*, 113264.
- Guo, J., Liu, C., Kong, D., Solomon, P., & Fu, M. (2018). The relationship between PTSD and suicidality among Wenchuan earthquake survivors: The role of PTG and social support. *Journal of Affective Disorders*, 235, 90–95.
- Haktanir, A., Seki, T., & Dilmaç, B. (2020). Adaptation and evaluation of Turkish version of the fear of COVID-19 scale. *Death Studies*, 1–9.
- Hall, B. J., Hobfoll, S. E., Palmieri, P. A., Canetti-Nisim, D., Shapira, O., Johnson, R. J., & Galea, S. (2008). The psychological impact of impending forced settler disengagement in Gaza: Trauma and posttraumatic growth. *Journal of Traumatic Stress*, 21(1), 22–29.
- Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.
- Ho, R. T., Lai, A. H., Lo, P. H., Nan, J. K., & Pon, A. K. (2017). A strength-based arts and play support program for young survivors in post-quake China: Effects on self-efficacy, peer support, and anxiety. *The Journal of Early Adolescence*, 37(6), 805–824.
- Hu, T., Wang, Y., Lin, L., & Tang, W. (2021). The mediating role of daytime sleepiness between problematic smartphone use and post-traumatic symptoms in COVID-19 home-refined adolescents. *Children and Youth Services Review*, 126, 106012.
- Huang, Y., & Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: A web-based cross-sectional survey. *Psychiatry Research*, 288, 112954.
- Jerusalem, M., & Hessling, J. K. (2009). Mental health promotion in schools by strengthening self-efficacy. *Health education*.
- Jin, Y., Xu, J., & Liu, D. (2014). The relationship between post traumatic stress disorder and post traumatic growth: Gender differences in PTG and PTSD subgroups. *Social Psychiatry and Psychiatric Epidemiology*, 49(12), 1903–1910.
- Joseph, S., Murphy, D., & Regel, S. (2012). An affective–cognitive processing model of post-traumatic growth. *Clinical Psychology & Psychotherapy*, 19(4), 316–325.
- Jovanovic, T., & Ressler, K. J. (2010). How the neurocircuitry and genetics of fear inhibition may inform our understanding of PTSD. *American Journal of Psychiatry*, 167(6), 648–662.
- Karademas, E. C. (2006). Self-efficacy, social support and well-being: The mediating role of optimism. *Personality and Individual Differences*, 40(6), 1281–1290.
- Kaye-Tzadok, A., & Davidson-Arad, B. (2016). Posttraumatic growth among women survivors of childhood sexual abuse: Its relation to cognitive strategies, posttraumatic symptoms, and resilience. *Psychological trauma: theory, research, practice, and policy*, 8(5), 550.
- Kleim, B., & Ehlers, A. (2009). Evidence for a curvilinear relationship between posttraumatic growth and posttrauma depression and PTSD in assault survivors. *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies*, 22(1), 45–52.
- Lau, J. T., Yang, X., Tsui, H., Pang, E., & Wing, Y. K. (2006). Positive mental health-related impacts of the SARS epidemic on the general public in Hong Kong and their associations with other negative impacts. *Journal of Infection*, 53(2), 114–124.
- Lau, J. T., Yeung, N. C., Yu, X., Zhang, J., Mak, W. W., Lui, W. W., & Zhang, J. (2015). Psychometric properties of the Chinese version of the revised posttraumatic growth inventory for children (PTGI-CR). *Asia Pacific. Journal of Public Health*, 27(2), NP1310–NP1320.
- Laufer, A., & Solomon, Z. (2006). Posttraumatic symptoms and post-traumatic growth among Israeli youth exposed to terror incidents. *Journal of Social and Clinical Psychology*, 25(4), 429–447.
- Lester, D. (1969). Fear of death and nightmare experiences. *Psychological Reports*, 25(2), 437–438.
- Li, Y., Duan, W., & Chen, Z. (2020). Latent profiles of the comorbidity of the symptoms for posttraumatic stress disorder and generalized anxiety disorder among children and adolescents who are susceptible to COVID-19. *Children and Youth Services Review*, 116, 105235.
- Linley, P. A., & Joseph, S. (2004). Positive change following trauma and adversity: A review. *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies*, 17(1), 11–21.
- Liu, Q., Zhou, Y., Xie, X., Xue, Q., Zhu, K., Wan, Z., Wu, H., Zhang, J., & Song, R. (2021). The prevalence of behavioral problems among school-aged children in home quarantine during the COVID-19 pandemic in China. *Journal of Affective Disorders*, 279, 412–416.
- Lotfi-Kashani, F., Vaziri, S., Akbari, M. E., Kazemi-Zanjani, N., & Shamkoevan, L. (2014). Predicting post traumatic growth based upon self-efficacy and perceived social support in cancer patients. *Iranian journal of cancer prevention*, 7(3), 115.
- Lowe, S. R., Manove, E. E., & Rhodes, J. E. (2013). Posttraumatic stress and posttraumatic growth among low-income mothers who survived hurricane Katrina. *Journal of Consulting and Clinical Psychology*, 81(5), 877.
- Mamun, M. A., Sakib, N., Gozal, D., Bhuiyan, A. I., Hossain, S., Bodrud-Doza, M., Al Mamun, F., Hosen, I., Safiq, M. B., & Abdullah, A. H. (2021). The COVID-19 pandemic and serious psychological consequences in Bangladesh: A population-based nationwide study. *Journal of Affective Disorders*, 279, 462–472.
- Mathews, A., Fox, E., Yiend, J., & Calder, A. (2003). The face of fear: Effects of eye gaze and emotion on visual attention. *Visual Cognition*, 10(7), 823–835.
- Milad, M. R., Orr, S. P., Lasko, N. B., Chang, Y., Rauch, S. L., & Pitman, R. K. (2008). Presence and acquired origin of reduced recall for fear extinction in PTSD: Results of a twin study. *Journal of Psychiatric Research*, 42(7), 515–520.
- Milad, M. R., Rosenbaum, B. L., & Simon, N. M. (2014). Neuroscience of fear extinction: Implications for assessment and treatment of fear-based and anxiety related disorders. *Behaviour Research and Therapy*, 62, 17–23.
- Murata, S., Rezeppa, T., Thoma, B., Marengo, L., Krancevich, K., Chiyka, E., Hayes, B., Goodfriend, E., Deal, M., & Zhong, Y. (2021). The psychiatric sequelae of the COVID-19 pandemic in adolescents, adults, and health care workers. *Depression and Anxiety*, 38(2), 233–246.
- Ornell, F., Schuch, J. B., Sordi, A. O., & Kessler, F. H. P. (2020). “Pandemic fear” and COVID-19: Mental health burden and strategies. *Brazilian Journal of Psychiatry*, 42(3), 232–235.
- Parto, M., & Besharat, M. A. (2011). The direct and indirect effects of self-efficacy and problem solving on mental health in adolescents: Assessing the role of coping strategies as mediating mechanism. *Procedia-Social and Behavioral Sciences*, 30, 639–643.
- Perrin, S., Meiser-Stedman, R., & Smith, P. (2005). The Children’s revised impact of event scale (CRIES): Validity as a screening instrument for PTSD. *Behavioural and Cognitive Psychotherapy*, 33(4), 487–498.

- Racine, N., Cooke, J. L., Eirich, R., Korczak, D. J., McArthur, B., & Madigan, S. (2020). *Child and adolescent mental illness during COVID-19: A rapid review*. Psychiatry research.
- Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., & Otto, C. (2021). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *European Child & Adolescent Psychiatry*, 1–11.
- Rodríguez-Rey, R., Palacios, A., Alonso-Tapia, J., Pérez, E., Álvarez, E., Coca, A., Mencía, S., Marcos, A. M., Mayordomo-Colunga, J., & Fernández, F. (2017). Posttraumatic growth in pediatric intensive care personnel: Dependence on resilience and coping strategies. *Psychological trauma: theory, research, practice, and policy*, 9(4), 407.
- Roussos, A., Goenjian, A. K., Steinberg, A. M., Sotiropoulou, C., Kakaki, M., Kabakos, C., Karagianni, S., & Manouras, V. (2005). Posttraumatic stress and depressive reactions among children and adolescents after the 1999 earthquake in Ano Liosia, Greece. *American Journal of Psychiatry*, 162(3), 530–537.
- Satici, B., Gocet-Tekin, E., Deniz, M. E., & Satici, S. A. (2020). Adaptation of the fear of COVID-19 scale: Its association with psychological distress and life satisfaction in Turkey. *International Journal of Mental Health and Addiction*, 1–9.
- Schunk, D. H., & Miller, S. D. (2002). Self-efficacy and adolescents' motivation. *Academic motivation of adolescents*, 2, 29–52.
- Singh, S., Roy, M. D., Sinha, C. P. T. M. K., Parveen, C. P. T. M. S., Sharma, C. P. T. G., & Joshi, C. P. T. G. (2020). Impact of COVID-19 and lockdown on mental health of children and adolescents: A narrative review with recommendations. *Psychiatry Research*, 113429.
- Smith, P., Perrin, S., Dyregrov, A., & Yule, W. (2003). Principal components analysis of the impact of event scale with children in war. *Personality and Individual Differences*, 34(2), 315–322.
- Sprang, G., & Silman, M. (2013). Posttraumatic stress disorder in parents and youth after health-related disasters. *Disaster Medicine and Public Health Preparedness*, 7(1), 105–110.
- Tang, S., Xiang, M., Cheung, T., & Xiang, Y.-T. (2021). Mental health and its correlates among children and adolescents during COVID-19 school closure: The importance of parent-child discussion. *Journal of Affective Disorders*, 279, 353–360.
- Tang, W., Hu, T., Hu, B., Jin, C., Wang, G., Xie, C., Chen, S., & Xu, J. (2020a). Prevalence and correlates of PTSD and depressive symptoms one month after the outbreak of the COVID-19 epidemic in a sample of home-quarantined Chinese university students. *Journal of Affective Disorders*, 274, 1–7.
- Tang, W., Hu, T., Yang, L., & Xu, J. (2020b). The role of alexithymia in the mental health problems of home-quarantined university students during the COVID-19 pandemic in China. *Personality and Individual Differences*, 165, 110131.
- Tang, W., Wang, Y., Lu, L., Lu, Y., & Xu, J. (2020c). Post-traumatic growth among 5195 adolescents at 8.5 years after exposure to the Wenchuan earthquake: Roles of post-traumatic stress disorder and self-esteem. *Journal of Health Psychology*, 1359105320913947.
- Tang, W., Zhao, J., Lu, Y., Zha, Y., Liu, H., Sun, Y., Zhang, J., Yang, Y., & Xu, J. (2018). Suicidality, posttraumatic stress, and depressive reactions after earthquake and maltreatment: A cross-sectional survey of a random sample of 6132 Chinese children and adolescents. *Journal of Affective Disorders*, 232, 363–369.
- Tedeschi, R. G., & Calhoun, L. G. (1996). The posttraumatic growth inventory: Measuring the positive legacy of trauma. *Journal of Traumatic Stress*, 9(3), 455–471.
- Xiong, J., Lipsitz, O., Nasri, F., Lui, L. M., Gill, H., Phan, L., Chen-Li, D., Iacobucci, M., Ho, R., & Majeed, A. (2020). Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *Journal of affective disorders*.
- Yang, C., Xia, M., & Zhou, Y. (2020). How is perceived social support linked to life satisfaction for individuals with substance-use disorders? The mediating role of resilience and positive affect. *Current Psychology*, 1–14.
- Yue, J., Zang, X., Le, Y., & An, Y. (2020). Anxiety, depression and PTSD among children and their parent during 2019 novel coronavirus disease (COVID-19) outbreak in China. *Current Psychology*, 1–8.
- Zhang, C., Ye, M., Fu, Y., Yang, M., Luo, F., Yuan, J., & Tao, Q. (2020). The psychological impact of the COVID-19 pandemic on teenagers in China. *Journal of Adolescent Health*, 67(6), 747–755.
- Zhang, J., Zhu, S., Du, C., & Zhang, Y. (2015). Posttraumatic stress disorder and somatic symptoms among child and adolescent survivors following the Lushan earthquake in China: A six-month longitudinal study. *Journal of Psychosomatic Research*, 79(2), 100–106.
- Zhang, J. X., & Schwarzer, R. (1995). Measuring optimistic self-beliefs: A Chinese adaptation of the general self-efficacy scale. *Psychologia: An International Journal of Psychology in the Orient*.
- Zhang, Y., Cao, X., Xie, Y., Zhong, Q., Lei, G., Zhang, J., Xiao, Q., Wang, G., Bian, Y., & Xie, S. (2021). Psychological stress of university students in the hardest-hit areas at different stages of the COVID-19 epidemic. *Children and Youth Services Review*, 125, 105980.
- Zhang, Y., & Ma, Z. F. (2020). Impact of the COVID-19 pandemic on mental health and quality of life among local residents in Liaoning Province, China: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 17(7), 2381.
- Zhou, S.-J., Zhang, L.-G., Wang, L.-L., Guo, Z.-C., Wang, J.-Q., Chen, J.-C., Liu, M., Chen, X., & Chen, J.-X. (2020). Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. *European Child & Adolescent Psychiatry*, 29(6), 749–758.
- Zhou, X. (2020). Managing psychological distress in children and adolescents following the COVID-19 epidemic: A cooperative approach. *Psychological trauma: theory, research, practice, and policy*.
- Zhou, X., & Wu, X. (2016). The relationship between rumination, post-traumatic stress disorder, and posttraumatic growth among Chinese adolescents after earthquake: A longitudinal study. *Journal of Affective Disorders*, 193, 242–248.
- Zoellner, L. A., Pruitt, L. D., Farach, F. J., & Jun, J. J. (2014). Understanding heterogeneity in PTSD: Fear, dysphoria, and distress. *Depression and Anxiety*, 31(2), 97–106.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.