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The Impact of Positive Youth Development Attributes on Posttraumatic Stress Disorder Symptoms Among Chinese Adolescents Under COVID-19

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A B S T R A C T

Purpose: This study examined the prevalence of posttraumatic stress disorder (PTSD) symptoms among adolescents in mainland China under COVID-19. The direct effects of the perceived threat of COVID-19 and positive youth development (PYD) qualities, as well as the moderating effect of PYD qualities on PTSD symptoms, were studied.
Methods: Five schools in Chengdu, Sichuan, China, participated in this study. Two waves of data were collected before school lockdown (Wave 1, between December 2019 and January 2020) and after school resumption (Wave 2, between June 2020 and July 2020), respectively. A total of 4,981 adolescents aged above 11 years (Mean age = 13.15, SD = 1.32 at Wave 1, 51.5% girls) completed questionnaires at both waves. Students responded to measures of PYD qualities at both waves and perceived threat and PTSD symptoms at Wave 2.
Results: A total of 517 adolescents (10.4%) could be regarded as having PTSD. Results indicated significant unique main effects of perceived threat ($\beta = .13$, $p < .001$) and Wave 1 PYD qualities ($\beta = -.16$, $p < .001$) on PTSD symptoms. Besides, results showed a significant moderating effect of PYD qualities in mitigating the negative impact of perceived threat on PTSD symptoms.
Conclusions: This study revealed the protective effect of PYD attributes in reducing the negative influence of traumatic situations such as COVID-19 on adolescent mental health. Results underscore the importance of promoting PYD qualities in adolescents in mainland China via effective PYD programs.

IMPLICATIONS AND CONTRIBUTION

This study highlights the importance of promoting positive youth development (PYD) qualities in buffering the negative psychological impact of the perceived threat of COVID-19 on posttraumatic stress disorder symptoms. Youth workers should implement PYD programs as early as possible for preparing adolescents to effectively cope with trauma such as COVID-19.

COVID-19 has brought tremendous challenges to individuals, families, societies, and the world. The increased number of confirmed cases and deaths, lockdown, and quarantine have imposed considerable pressure on the general public and helping professionals, including pediatricians and social workers [1]. For individuals, it is a significant stressor triggering negative emotions of fear, loneliness, panic, anxiety, loneliness, depression, and general psychiatric morbidity [2–4].

With specific reference to adolescent adjustment under COVID-19, there are three areas of research that pediatricians and allied professionals should conduct. First, we should understand the well-being of adolescents under COVID-19, which has important intervention implications. For example, COVID-19

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may constitute trauma and generate symptoms related to post-traumatic stress disorder (PTSD) for some adolescents, which requires intervention. Second, to identify "high-risk" adolescents for early intervention, researchers should investigate determinants of the well-being of adolescents under COVID-19, such as sociodemographic background attributes and ecological factors. For example, perceived stress [5] and uncertainty stress [6] have been found to be risk factors for adolescent well-being. These findings echo the prediction of the transactional theory of stress and coping that the impact of stress is a function of primary appraisal (i.e., whether there is perceived threat) and secondary appraisal (i.e., possibility of mobilizing effective coping responses [7]. Finally, Shek [8] argued that it is important to understand mitigating factors of the negative impacts of risk factors (such as the perceived threat of COVID-19) on adolescent well-being (i.e., protective factors). Unfortunately, as Gotzinger et al. [9] remarked, "to date, few data on pediatric COVID-19 have been published" (p. 653).

Earlier research on COVID-19 has mainly focused on the well-being and mental health issues of confirmed patients and frontline professionals [e.g., [10,11]], with relatively less attention paid to adolescents as they have a lower chance of infection and milder illness symptoms in comparison to adults [12]. Developmentally speaking, COVID-19 may have several negative impacts on adolescent adjustment. First, school lockdown and use of online teaching create burdens for students, such as staring at the screen for a long time and completing the assignments online without peer discussion. The related academic burdens would be intensified when the home Wi-Fi connection is unstable and siblings compete for Wi-Fi bandwidth and computer use. In fact, due to ineffective monitoring, evaluation, and unstable network, students may experience learning difficulties and increase excessive Internet/smartphone use during this period [4]. Second, school lockdown also means a reduction in teacher guidance and peer interaction, which are important sources of support for adolescents. Third, increased time of staying at home may lead to a higher chance for parent-child conflict on issues of supervision, such as usage of computer and daily routines. Although family cohesion may improve during home confinement, family conflicts could increase due to parents' additional caregiving burden and insufficient social support of the family [13]. Fourth, city lockdown and reduced economic activities would impose financial stress, such as a salary reduction and forced unpaid leave for employed parents, on grassroots families, which would further impair family processes. It is well-documented in the scientific literature that economic disadvantage is a risk factor negatively affecting effective parenting and the harmonious parent-child relationship. Finally, with the growing number of confirmed cases, death tolls, unemployment, and criticisms of Government policy on city lockdown, COVID-19 also generates a negative community atmosphere making adolescents feel insecure and anxious.

Empirically, some studies showed that late adolescents and emerging adults are risky for psychiatric disorders under COVID-19. For example, Cohen et al. [14] examined COVID-19 related experiences in 725 full-time college students. Lee et al. [15] revealed that loneliness and depression in young adults increased during COVID-19. Kecojevic et al. [16] showed that college students (N = 162) encountered difficulties in different life domains. Li et al. [1] also found that the mental health of college students deteriorated after confinement. In contrast, relatively fewer studies have been conducted with early and middle adolescents. This is understandable because the data from early and middle adolescents are relatively difficult to collect during the lockdown period. Nevertheless, compared to late adolescents, early and middle adolescents may experience greater stress because they lack proper coping strategies and rational, emotional reactions [2]. In addition, due to relatively more intense parent-child relationship and potentially higher parent-adolescent conflict during early and middle adolescence, early adolescents may face COVID-19 with lesser family support. Among the limited scientific literature, studies showed that COVID-19 impaired well-being of adolescents: Duan et al. [4] revealed that 22.2% of the sampled children and adolescents experienced anxiety and depression during COVID-19; Liang et al. [17] suggested that 14.4% of the sampled youth showed PTSD symptoms; Tang et al. [18] also demonstrated severe negative psychological consequences of COVID-19 among home-quarantined students, such as PTSD and depressive symptoms.

Another gap in the literature is that few studies have examined protective factors on the influence of COVID-19 on adolescent well-being [19]. Although the COVID-19 pandemic presents a significant threat to people's physical and mental health, individuals' responses to stressful situations are also profoundly influenced by protective factors, such as individual internal assets (e.g., resilience and a positive view of the future) and external assets (e.g., social support) [13,19]. For example, Yu et al.'s research [20] revealed the importance of active coping strategies and social support in reducing the psychological distress of the general Chinese population. Similarly, Zheng and colleagues' study [21] also suggested that a sense of control is a protective factor in buffering the negative influence of COVID-19 on participant's health and life satisfaction. Ren et al. [22] showed that exercise and adhering to daily routines were significant moderators.

With specific reference to the positive youth development (PYD) approach [23,24], although there are different PYD models, one common proposition is that developmental assets are factors facilitating adolescent development. For example, internal assets (such as psychosocial competence and spirituality) and external assets (such as bonding and caring family environment) are positively related to adolescent developmental outcomes. Besides, possessing strong PYD qualities, such as emotional competence and resilience, can protect adolescents in stressful situations [8]. For example, strong cognitive competence and a sense of control could enhance one's ability and confidence in evaluating stressful situations, coping with stressors, and handling outcomes [21]. A study involving 7,800 adolescents revealed the protective role of resilience in the influence of stressful COVID-19 related experiences on mental disorders [19]. Cultivating PYD qualities has been recognized as an effective method for adolescents to actively and appropriately cope with challenges and regulate emotions during stressful events [23].

The present study attempted to fill the research gaps by examining the PTSD symptoms of adolescents in mainland China under COVID-19. We explored the perceived threat of COVID-19 among Chinese adolescents, the prevalence of PTSD symptoms, and the psychological mechanisms through which perceived threat of COVID-19 could influence adolescents' PTSD symptoms. This study attempted to answer the following research questions:

1. What is the perceived threat of COVID-19 among adolescents in mainland China?

2. What are the prevalence of PTSD symptoms and the response profiles of adolescents in mainland China?
3. What is the relationship between perceived threat and PTSD symptoms? Based on the transactional theory of stress and coping [25] and previous findings [11,17,18], we hypothesized that there would be a positive relationship between perceived threat and PTSD symptoms (Hypothesis 1).
4. What is the relationship between PYD qualities and PTSD symptoms? According to theoretical considerations and empirical findings [19,21,26], we hypothesized that PYD qualities would be negatively associated with PTSD symptoms (Hypothesis 2).
5. Do PYD qualities moderate the relationship between perceived threat and PTSD symptoms? Existing PYD models and related findings suggest that PYD qualities could buffer the negative influences of stressful situations on adolescents' mental health [23,27]. Therefore, we also hypothesized a moderating effect of PYD qualities on the influence of perceived threat and PTSD symptoms (Hypothesis 3).

Methods

Participants and procedure

Five schools in Chengdu were selected to join the present study using a random cluster sampling procedure. Specifically, one school in the Central district, two schools in the South district, and two schools in the North district were selected. Among these schools, two were elementary schools, one was secondary school, and the other two admitted both elementary and secondary school students. All students in the selected schools were invited to participate in the study. Two waves of data were collected in classroom settings with the presence of two well-trained research assistants in each classroom. Wave 1 data were collected between December 23, 2019, and January 13, 2020, just before the outbreak of the COVID-19 in Wuhan, China and prior to school lockdown. Wave 2 data were collected in reopened schools between June 16, 2020, and July 8, 2020, when the epidemic was under control in China and after school resumption. This project received ethical approval from Sichuan University. Well-informed written consent was obtained from the participating schools, students, and their parents.

The present study focused on adolescents aged 11 years or above. A total of 5,690 and 4,981 questionnaires with completed data were collected at Wave 1 and Wave 2, respectively. Some adolescents did not respond to the questionnaire because they were absent at the time of data collection. The present study used the sample with complete data at both waves (N = 4,981, Mean age = 13.15, SD = 1.32 at Wave 1), among whom 2,566 (51.5%) were boys and 2,415 (48.5%) were girls.

Instrument

PYD qualities. Adolescents' PYD qualities were assessed at both waves using the Chinese Positive Youth Development Scale (CPYDS), which consisted of 80 items measuring 15 psychosocial competencies, such as emotional competence, resilience, bonding with others, and self-efficacy [26]. These PYD attributes were derived from the work of Catalano and his associates [26] that these 15 PYD attributes could be identified in the effective PYD programs in the United States. All items were rated on a 6-point scale (1 = "strongly disagree," 6 = "strongly agree"). This scale was validated in the Chinese context [28] and widely used to measure Chinese adolescents' PYD attributes in previous studies [27,29]. In the present study, the scale showed good internal consistency (see Table 1).

Perceived threat of COVID-19. Adolescents' perceptions of the threat of COVID-19 were assessed at Wave 2 by three items, including perceived severity of the epidemic, the danger of the infection, and the likelihood of being infected. The three items were rated from 1 (not at all) to 4 (very much), with a higher score suggesting a higher level of perceived threat. Although the alpha value was not high (see Table 1), it is acceptable given that there were only three items. Besides, the mean inter-item and item-total correlations were not low.

PTSD symptoms. Adolescents' PTSD symptoms were assessed at Wave 2 using the Children's Revised Impact of Event Scale (CRIES-13) that has good psychometric properties. The validated Chinese version of the Children's Revised Impact of Event Scale (CRIES-13) was adopted to measure participants' posttraumatic stress disorder after COVID-19 [30,31]. This scale was used as an objective assessment tool for screening PTSD symptoms after different traumatic events (e.g., earthquake) among Chinese children and adolescents [32,33]. Participants were asked to rate the frequency of occurrence of each symptom using a 4-point scale (0 = "never," 1 = "rarely," 3 = "sometimes," and 5 = "a lot"), resulting in total scores ranging from 0 to 65. Based on existing literature [30], a cutoff score of 30 was applied to indicate the prevalence of PTSD. In the present study, the scale showed adequate internal consistency (see Table 1).

Data analytical plan

Data analyses were conducted using SPSS (version 26.0). Descriptive analyses were performed to depict response profiles of the perceived threat and PTSD symptoms, followed by correlational analyses among the variables. Finally, hierarchical regression analyses were conducted to examine the main effects of the perceived threat and PYD qualities, as well as their interactive effect on PTSD symptoms. As some sociodemographic variables (such as age, gender, the existence of siblings, and parents' educational level) may be related to adolescent mental health [4,17], the related covariates were statistically controlled in the following regression analyses. Bootstrapped bias-corrected (BC) 95% confidence intervals (CIs) were calculated for regression coefficients using 2,000 re-samplings [34].

Results

Response profiles

As shown in Table 2, more than 90% of the adolescents perceived COVID-19 as moderate to very severe and dangerous. However, relatively fewer adolescents (38.4%) thought that they were likely to be infected by COVID-19. For PTSD symptoms, around 15%–28% of the adolescents displayed PTSD symptoms (see Table 3). For example, 872 (17.5%) and 516 (10.4%) adolescents sometimes and frequently, respectively, had waves of strong feelings about COVID-19. There were 517 adolescents scored 30 or above, with a prevalence rate of 10.4% of excessive PTSD symptoms.

Table 1
Reliability, descriptions, and correlations

Variable	Reliability			Descriptions			Correlations							
	Cronbach's α	Mean IIC	Mean ITC	Range	Mean	SD	1	2	3	4	5	6	7	8
1. Age at Wave 1				11–20	13.15	1.32	–							
2. Gender[a]				1–2			.01	–						
3. Having siblings[b]				1–2			−.03*	.04**	–					
4. Father education[c]				1–5			−.08***	−.04**	−.20***	–				
5. Mother education[c]				1–5			−.10***	−.02	−.23***	.65***	–			
6. Parent-child relationship				1–10	8.46	1.89	−.14***	.02	−.08***	.09***	.11***	–		
7. PYD at Wave 1	.98	.38	.61	1–6	5.04	.75	−.19***	.01	−.07***	.15***	.16***	.33***	–	
8. Perceived threat at Wave 2	.57	.31	.37	1–4	3.14	.55	−.01	−.03*	.04**	−.04*	−.03*	.01	.03	–
9. PTSD symptoms at Wave 2	.89	.39	.59	0–5	13.34	13.09	−.04**	.02	−.05***	−.05**	−.05**	−.11***	−.16***	.14***

IIC = inter-item correlation; ITC = item-total correlation; PYD = Positive youth development qualities.
*$p < .05$; **$p < .05$; ***$p < .001$.
[a] Male = 1, Female = 2.
[b] No = 1, Yes = 2.
[c] Primary school or lower = 1, Junior secondary school = 2, Senior Secondary school = 3, Diploma = 4, Undergraduate or higher = 5.

Main effects of perceived threat and PYD and their interactions on PTSD

Regarding the control variables, although some background sociodemographic variables (including age, gender, the existence of siblings, and parents' educational level) and parent-child relationship were correlated with PTSD, the related effect sizes were small (r^2 ranged from .0004 to .01), suggesting that they did not have great influence on the development of PTSD symptoms. However, as they are statistically significant, these variables were statistically controlled in the multiple regression analyses.

As expected, perceived threat of COVID-19 was positively associated with PTSD ($r = .14$, $p < .001$) while Wave 1 PYD was negatively correlated with PTSD ($r = -.16$, $p < .001$, see Table 1). The results of hierarchical regression analyses indicated significant main effects of perceived threat ($B = 3.12$, BC 95% CI = [2.46, 3.78], $\beta = .13$, $p < .001$, Cohen's $f^2 = .018$) and Wave 1 PYD qualities ($B = -2.80$, BC 95% CI = [−3.31, −2.28], $\beta = -.16$, $p < .001$, Cohen's $f^2 = .023$, see Table 4) on PTSD. These findings provided support for Hypothesis 1 and Hypothesis 2.

In addition, a significant interaction was also identified ($B = -.47$, BC 95% CI = [−.79, −.14], $\beta = -.04$, $p < .01$, Cohen's $f^2 = .002$), suggesting that the prediction of perceived threat was moderated by PYD qualities. Analysis of the simple slopes (see Figure 1) suggested that the relation between perceived threat and PTSD symptoms was stronger for adolescents who scored low (−1 SD) on Wave 1 PYD qualities ($B = 4.15$, BC 95% CI = [2.21, 5.96], $\beta = .19$, $p < .001$, Cohen's $f^2 = .037$) than for those who reported high (+1 *SD*) PYD qualities at Wave 1 ($B = 2.23$, BC 95% CI = [.68, 3.83], $\beta = .10$, $p < .01$, Cohen's $f^2 = .009$). The findings gave evidence for Hypothesis 3.

Discussion

This study provides several constructive responses to the limitations of adolescent research [8]. Conceptually, the present study was guided by the PYD perspective, which regards PYD attributes as a predictor, as well as a protective factor for adolescent adjustment under COVID-19. Methodologically, this study has several unique features. First, we focused on early and middle adolescents who have received less attention in the COVID-19 literature. Second, in response to the lack of Chinese adolescent well-being studies, the study was conducted in mainland China. Third, instead of convenience sampling used in most existing studies, we randomly selected five schools in Chengdu, Sichuan Province of China. Fourth, a large sample was employed in this study to ensure adequate power in statistical analyses. Fifth, we employed tools with good psychometric properties to assess PYD qualities and PTSD symptoms. Sixth, instead of using a cross-sectional design, we employed a short-term longitudinal study to examine the related hypotheses. Finally, we examined the main effects of the perceived threat and PYD qualities, as well as the moderating effect of PYD qualities.

Regarding the profile of responses to the items of CRIES-13, there are several interesting observations. First, more than a quarter of the students had waves of strong feelings about COVID-19 (Item 4: 27.9%). Second, more than one-quarter of the students had intrusive pictures (Item 8: 27.8%), and more than one-fifth of the students showed heightened sensitivity (Item 9: 22.8%) about COVID-19. Third, more than one-fifth of the respondents showed symptoms of irritability (Item 11: 21.5%) and hyper-alertness (Item 12: 24.5%). Fourth, roughly one-10th of the students could be classified as having excessive PTSD symptoms. These findings are in line with those obtained by Liang et al. [17]

Table 2
Perceived threat of COVID-19

	Items	1 = Not at all n (%)	2 = Somewhat n (%)	3 = Moderate n (%)	4 = Very n (%)	Total N
1	How severe is the COVID-19 epidemic?	144 (2.9%)	313 (6.3%)	1,278 (25.7%)	3,246 (65.2%)	4,981
2	How dangerous is it to be infected by COVID-19?	77 (1.5%)	251 (5.0%)	1,064 (21.4%)	3,589 (72.1%)	4,981
3	How likely will you be infected by COVID-19?	1,033 (20.7%)	2,033 (40.8%)	1,500 (30.1%)	415 (8.3%)	4,981

Table 3
Response profiles of PTSD symptoms measured by CRIES-13 among adolescents

Items		0 = Never n (%)	1 = Rarely n (%)	3 = Sometimes n (%)	5 = A lot n (%)	Total N
1	Did you think about COVID-19 when you did not mean to?	2,474 (49.7%)	1,483 (29.8%)	632 (12.7%)	392 (7.9%)	4,981
2	Did you try to remove COVID-19 from your memory?	2,879 (57.8%)	1,062 (21.3%)	516 (10.4%)	524 (10.5%)	4,981
3	Did you have difficulties paying attention or concentrating?	2,730 (54.8%)	1,298 (26.1%)	652 (13.1%)	301 (6.0%)	4,981
4	Did you have waves of strong feelings about COVID-19?	2,330 (46.8%)	1,263 (25.4%)	872 (17.5%)	516 (10.4%)	4,981
5	Did you startle more easily or feel more nervous than you did before COVID-19 happened?	3,096 (62.2%)	1,081 (21.7%)	515 (10.3%)	289 (5.8%)	4,981
6	Did you stay away from reminders of COVID-19?	3,126 (62.8%)	1,068 (21.4%)	472 (9.5%)	315 (6.3%)	4,981
7	Did you try not to talk about COVID-19?	2,849 (57.2%)	1,150 (23.1%)	536 (10.8%)	446 (9.0%)	4,981
8	Did pictures about COVID-19 pop into your mind?	2,330 (46.8%)	1,266 (25.4%)	895 (18.0%)	490 (9.8%)	4,981
9	Did other things keep making you think about COVID-19?	2,545 (51.1%)	1,299 (26.1%)	746 (15.0%)	391 (7.8%)	4,981
10	Did you try not to think about COVID-19?	3,027 (60.8%)	1,090 (21.9%)	455 (9.1%)	409 (8.2%)	4,981
11	Did you get easily irritable?	2,653 (53.3%)	1,259 (25.3%)	671 (13.5%)	398 (8.0%)	4,981
12	Were you more alert and watchful even when there was no obvious need to be?	2,531 (50.8%)	1,232 (24.7%)	707 (14.2%)	511 (10.3%)	4,981
13	Did you have sleep problems?	3,232 (64.9%)	932 (18.7%)	505 (10.1%)	311 (6.2%)	4,980

With PTSD (i.e., total score $\geq$ 30): n = 517 (10.4%).
Without PTSD (i.e., total score $<$ 30): n = 4,463 (89.6%).

that around 14% of the respondents could be regarded as having excessive PTSD symptoms. Compared to a PTSD prevalence of 2.7% among college student samples [18], the prevalence rate of PTSD was higher in the high school student sample. This may be explained by the fact that college students possess more coping resources and skills than do early and middle adolescents.

The above observations suggest three directions for intervention. First, there is a need to conduct debriefing and psychoeducational programs for students under COVID-19. Primarily, clear information and proactive safety measures would be helpful to give a sense of control for the students. Although online training sessions may be available, very few studies reported such initiatives. Besides, intervention is needed for those students with excessive PTSD symptoms. Second, as inviting students to complete psychological assessment scales online would not be difficult, it would be helpful to routinely conduct assessments using rapid assessment instruments by teachers and allied professionals. By doing this, early identification and intervention are possible, which would eventually save lives. Finally, training should be provided to frontline teachers and allied professionals, such as school social workers and school nurses, to conduct such an initial assessment. Unfortunately, teachers and allied professionals commonly do not have adequate training in using rapid assessment tools in crisis situations such as COVID-19.

Consistent with our prediction, the perceived threat was positively related to CRIES scores. This finding is in line with the previous studies that perceived stress was positively related to

Table 4
Hierarchical regression analyses for the predictions of perceived threat and PYD on PTSD symptoms

Model	Predictor	*B*	*BC 95% CI*		*SE*	*Beta*	*t*	*Cohen's f^2*	*F* Change	R^2 change
			Lower	Upper						
1	Age at Wave 1	−.68	−.96	−.39	.15	−.07	−4.64***	.004	18.39***	.022
	Gender[a]	.46	−.27	1.20	.38	.02	1.23	.000		
	Having siblings[b]	1.67	.86	2.48	.41	.06	4.06***	.003		
	Father education[c]	−.24	−.66	.18	.21	−.02	−1.14	.000		
	Mother education[c]	−.33	−.74	.09	.21	−.03	−1.54	.000		
	Parent-child relationship	−.76	−.96	−.56	.10	−.11	−7.55***	.012		
2	Age at Wave 1	−.65	−.94	−.37	.14	−.07	−4.53***	.004	81.82***	.016
	Gender[a]	.59	−.14	1.32	.37	.02	1.57	.001		
	Having siblings[b]	1.54	.74	2.35	.41	.05	3.77***	.003		
	Father education[c]	−.21	−.62	.21	.21	−.02	−.97	.000		
	Mother education[c]	−.30	−.72	.11	.21	−.03	−1.44	.000		
	Parent-child relationship	−.77	−.97	−.58	.10	−.11	−7.75***	.012		
	Perceived threat	3.07	2.40	3.74	.34	.13	9.05***	.017		
3	Age at Wave 1	−.89	−1.17	−.60	.14	−.09	−6.14***	.008	57.93***	.023
	Gender[a]	.67	−.05	1.39	.37	.03	1.82	.001		
	Having siblings[b]	1.43	.64	2.22	.40	.05	3.53***	.003		
	Father education[c]	−.08	−.49	.33	.21	−.01	−.39	.000		
	Mother education[c]	−.19	−.60	.22	.21	−.02	−.93	.000		
	Parent-child relationship	−.47	−.67	−.26	.10	−.07	−4.52***	.004		
	Perceived threat	3.12	2.46	3.78	.34	.13	9.27***	.018		
	PYD at Wave 1	−2.80	−3.31	−2.28	.26	−.16	−10.57***	.023		
	Perceived threat × PYD at Wave 1	−.47	−.79	−.14	.17	−.04	−2.78**	.002		

**$p < .05$; ***$p < .001$.
[a] Male = 1, Female = 2.
[b] No = 1, Yes = 2.
[c] Primary school or lower = 1, Junior secondary school = 2, Senior Secondary school = 3, Diploma = 4, Undergraduate or higher = 5.

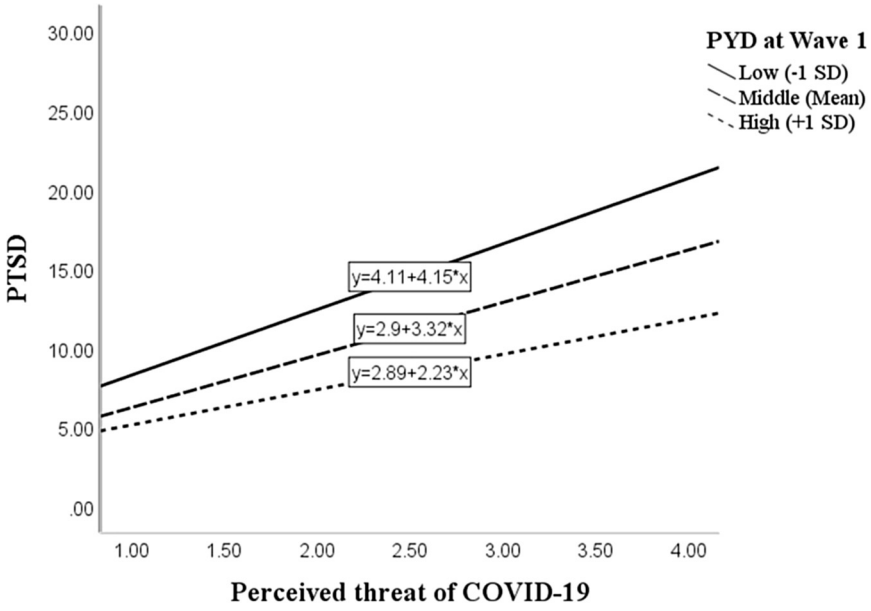

Figure 1. Moderating effect of PYD at Wave 1 on the relationship between perceived threat of COVID-19 and PTSD symptoms.

psychological morbidity [5,6] and the prediction of the stress-coping theory proposed by Lazarus and Folkman [7]. According to the stress-coping theory [7], perceived threat (i.e., primary appraisal) defines the "danger" of the situation and is positively related to psychological morbidity with the moderation of secondary appraisal. Practically speaking, it is important to help adolescents access accurate information (e.g., disciplined and effective hygiene measures such as wearing a face mask) and have a rational appraisal of COVID-19 and the related problems. At the same time, helping adolescents to develop cognitive competence (a PYD attribute) can facilitate the development of realistic perceptions of the stressors.

Our findings showed that Wave 1 PYD attributes negatively predicted PTSD at Wave 2. Furthermore, beyond the main effect of Wave 1 PYD attributes, a moderating effect of Wave 1 PYD attributes on the influence of perceived threat on PTSD symptoms was also found. These observations support the general thesis of PYD models that internal assets (such as resilience and optimism) and external developmental assets (such as bonding) are related to better adolescent outcomes [35]. There is also evidence showing the positive effect of PYD attributes in promoting developmental outcomes in Chinese adolescents [29,36]. In short, the present findings give support to the basic thesis of the PYD approach that developmental assets indexed by PYD attributes are positively related to well-being outcomes. Of course, if resources permit, it would be helpful to conduct additional waves of data collection with the same sample over a longer period of time and/or conduct new longitudinal studies with more waves of data.

Practically speaking, the present findings suggest the importance of strengthening PYD qualities in adolescents via PYD programs. As far as "what" PYD programs should be employed, three points should be noted. First, a higher dosage of developmentally appropriate programs would produce more beneficial effects (i.e., dosage effect). Second, it is important to employ evidence-based PYD programs with the support of evaluation findings. Third, there are validated programs in Western societies [26,37]. In different Chinese contexts, the Project P.A.T.H.S. and Tin Ka Ping Project P.A.T.H.S. showed that the related programs could promote students' psychosocial competencies [27,38]. The program was identified as a program that could promote well-being in adolescents [37,39]. Regarding the question of "when" to implement PYD programs, it is argued that such programs should be implemented as early as possible. In fact, there are studies supporting the value of implementing social-emotional learning programs in children and early adolescents [40]. With specific reference to infectious diseases such as COVID-19, implementing PYD programs when we encounter COVID-19 would be too late. Adolescents should get prepared for infectious diseases in the future. However, the concepts of early preparation and prevention are still not strong among the education sectors. This is particularly the case in mainland China where the focus on academic excellence is still very strong.

Despite its theoretical and practical contributions, this study has several limitations. First, the duration in-between the two time points is relatively short. However, this arrangement is regarded as reasonable because we collected data before and after school lockdown in Chengdu. Second, there are only three items in the assessment of the perceived threat. It would be helpful to employ more items to measure this construct. Third, although the schools were randomly selected, the sample was confined to one city in China. Hence, efforts to replicate the findings would be helpful. Fourth, as the effect size of the significant findings in the multiple regression analyses is relatively small, there is a need to replicate these findings in future studies. Finally, as coping was not assessed in this study, it would be illuminating if measures of coping (i.e., secondary appraisal) can be included in future studies.

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