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Trajectories of mental health status during the early phase pandemic in China: A longitudinal study on adolescents living in the community with confirmed cases

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ABSTRACT

Sufficient research reports that individuals living in the community with confirmed COVID-19 cases are more likely to exhibit poor mental health condition. However, little is known about the longitudinal trajectories of mental health status among these people who are exposed to increased risk of contracting COVID-19. Using a 3-wave longitudinal survey between February and June 2020, data has been collected from 2,352 adolescents living in the community with confirmed cases. Depressive/anxiety symptoms, socio-demographic, and other psychological factors of interest (e.g., social support) were measured. Using latent growth mixture modeling, we identified two subgroups (Resistance vs. Dysfunction) of adolescents based on their depressive and anxiety symptoms. More social support and positive coping are identified as protective factors for mental health, whereas higher level of negative coping predicts unfavorable outcomes. These findings suggested that adolescents living in the community with confirmed cases of COVID-19 are a group to which researchers should pay more attention when studying the impacts of quarantine on mental health. It is also crucial to emphasize the role of social support and positive coping in planning psychological interventions for adolescents.

1. Introduction

With the spread of COVID-19 across world since 2020, there is an increasing trend of mental health problems among individuals and various communities. A great number of studies have suggested that adolescents' mental health should be monitored during the pandemic (Torales et al., 2020). One latest survey of a large sample of Chinese adolescent has shown the prevalence rates of depression and anxiety being 21.1% and 11.0%, respectively during COVID-19 outbreak (Ma et al., 2020). Among a sample of American students, 48.14% have experienced moderate-to-severe level of depression, 38.48% with moderate-to-severe level of anxiety, and 18.04% have reported suicidal ideations during the COVID-19 pandemic (Wang et al., 2020a). As suggested by previous research, the risks of occurrence of mood disorders among adolescents during COVID-19 are associated with

demographic characteristics (e.g., female, graduation grades), personal living styles (e.g., screen time, sleep quality), and other psychosocial factors (e.g., resilience, perceived social support)

Due to the rising concerns about the COVID-19 pandemic, countries have undertaken confinement measures, including self-isolation, contact restrictions, and closure of schools, colleges, universities, and other educational institutions (Bedford et al., 2020). With the abrupt change of daily routine and social interactions, adolescents are particularly vulnerable during the quarantine periods and may be susceptible to psychological distress that extends beyond the crisis, which can greatly affect the psychological status of students (Sahu, 2020). Recent data found that level of psychological distress has significantly increased after one underwent quarantine (Pierce et al., 2020; Shanahan et al., 2020). These findings are in line with research results from previous Severe Acute Respiratory Syndrome (SARS) epidemic, during which

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individuals experienced increased psychiatric symptoms during periods of quarantine or enforced isolation (Liu et al., 2012; Mihashi et al., 2009; Reynolds et al., 2008).

In terms of the COVID-19 timeline in China, its outbreak was first revealed in late December 2019 in the city of Wuhan in Hubei province, which later began to spread across the country. Since the beginning of the spring academic semester (early March), the vast majority of adolescents have stayed home and completed courses online. As Chinese government has been actively containing the pandemic since the outbreak, there has been very few newly confirmed cases daily from May 2020 with a clear nationwide downward trend. Thus, a small number of schools and universities have gradually reopened their doors by that time (The State Council Information Office of the People's Republic of China, 2020). In a self-reported survey, many adolescents reported having family's income, academic activities, and social communication being affected to varying degrees due to the pandemic (Wang et al., 2021). However, little is known about the trajectories of evolution of adolescents' mental health throughout the course of COVID-19.

Furthermore, as regions of China were affected to various degrees, the local isolation measures could also be different at a given time. At the onset of the pandemic, World Health Organization divided China into three categories based on the number of COVID-19 confirmed cases in early 2020 (WHO, 2020): high-risk areas (Hubei province) = >10,000 confirmed cases; moderate-risk areas (e.g., Guangdong province) = 1000 - 9999 confirmed cases; low-risk areas (e.g., Sichuan province) = <1000 confirmed cases. In moderate to low risk areas, the principle of management mainly involved residents' self-health monitoring (e.g., daily temperature measurement). Residents were allowed to go out with masks and a non-exposure green health codes was required before entering restaurants and shopping malls. However, in a district had a confirmed COVID-19 positive patient, residents would be restricted from leaving the neighborhood with living necessities uniformly distributed by the local government institute. Nucleic acid tests would also be carried out regularly until the absence of newly confirmed cases for 14 consecutive days. Previous studies suggested that news about confirmed COVID-19 cases in communities could have adverse effects on adolescents' mental health by eliciting fear and anxiety. As an extremely contagious virus, COVID-19 could be transmitted through asymptomatic virus-carriers (Bai et al., 2020), which further increased adolescents' and their families' fear of new cases in their community.

Accordingly, we focused on depression and anxiety symptoms for adolescents with heightened risk of contracting COVID-19 (with confirmed cases in their community) during the quarantine period. This study had two main aims: first, to explore the trajectories of depressive

and anxiety symptoms over the quarantine period; and second, to identify those who were at highest risk of showing exacerbating trajectories of mental health.

2. Methods

2.1. Participants

Using a repeated cross-sectional study design, we have conducted three online investigations (Time 1, Outbreak phase: February 3 to February 10, 2020; Time 2, Initial remission phase: March 24 to April 3, 2020; Time 3, Control phase: June 1 to June 15, 2020) on adolescents in Guangdong province through convenient sampling during the COVID-19 (see Fig. 1). College students from 22 colleges/ universities in Guangzhou Province volunteered to participate in our online survey. Through data integration, a total of 35,516 adolescents completed all three surveys and provided valid data on all measures. Detailed sampling and data collection have been described in another study previous studies (Wang et al., 2022a, 2022b).

In moderate to low risk areas, the number of COVID-19 confirmed cases was relatively low. Guangdong province was a moderate-risk area that had 1000 to 9999 cumulative confirmed cases during the COVID-19 outbreak (WHO, 2020). Real-time data showed that as of 24:00 on June 1, 2020, Guangdong Province has reported a total of 1596 confirmed cases of COVID-19 (201 imported cases from abroad). Identify the sample of interest for this study through a question from the baseline survey- whether or not there were infected in your current living community? Among 35,516 participants, 2352 adolescents reported having confirmed cases in their community during COVID-19 outbreak (Time 1). These participated were included in the subsequent analyses.

This study was approved by the Human Research Ethics Committees of South China Normal University (Ethics No. SCNU-PSY-2020-01-001). Participation in this study was entirely voluntary, interested participants needed to sign an electronic informed consent form before the survey and could quit at any time. Participants were also provided access to mental health services from school of psychology, South China Normal University.

2.2. Measures

2.2.1. Soc-demographic variables

Soc-demographic variables were self-reported information on participants' gender, age, grade, residence location, whether they have siblings in their family, and whether they had history of physical or

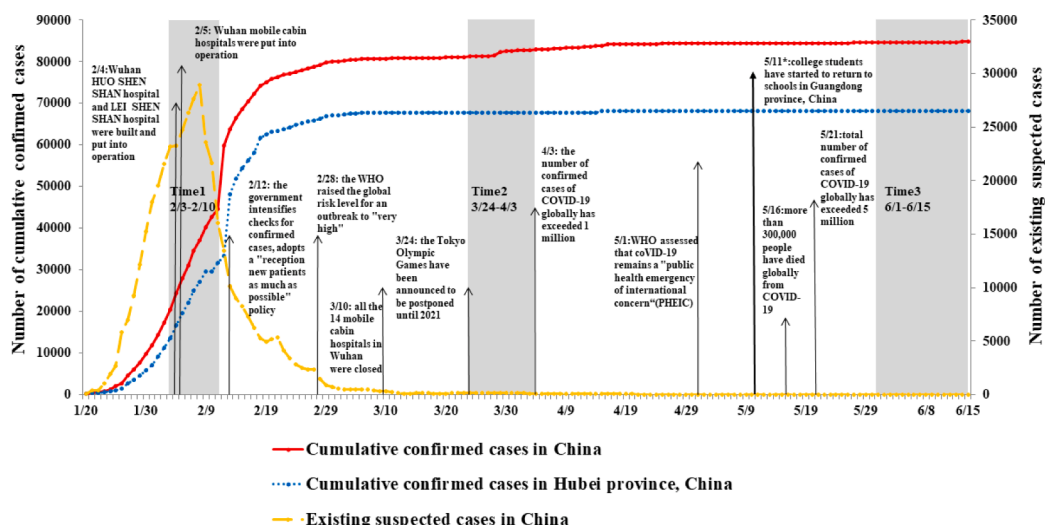


Fig. 1. The national pandemic trend of the 2019 coronavirus disease (COVID-19) in China and sampling time windows.

mental illness.

2.2.2. Depression and anxiety

The Patient Health Questionnaire (PHQ-9) was used to measure participants' depressive symptoms in the past two weeks prior to the survey. PHQ-9 is a practical self-report questionnaire where responses are coded on a 3-point scale, from 0 (not at all) to 3 (nearly every day), with a total score ranging from 0 to 27. A higher total score indicates greater tendency of depressive symptoms (Kroenke et al., 2001). Probable clinical depression was screened with the commonly accepted cut-off score of 7 in Chinese sample (Wang et al., 2014). The Cronbach's α of PHQ-9 were 0.88, 0.91 and 0.91 at three timepoints, respectively.

The Generalized Anxiety Disorder Scale (GAD-7) was used to measure students' anxiety symptoms in the past two weeks. Responses were recorded from 0 (not at all) to 3 (nearly every day), with a higher total score indicating a greater tendency of anxiety symptoms (Spitzer et al., 2006). A score of 7 or above could be considered as having potential clinical diagnoses of anxiety in Chinese sample (Tong et al., 2016). The Cronbach's α of GAD-7 were 0.92, 0.93 and 0.95 at three timepoints, respectively.

2.2.3. Other psychological factors of interest

Social support refers to the assistance or comfort provided by individuals' significant others to help them cope with biological, psychological, and social stressors (Thoits, 2011). In this study, the Perceived Social Support Scale (PSSS) was used to measure individual perceptions of available support from their family, friends, and other sources at Time 1. Twelve items are rated from 1 (very strongly disagree) to 7 (very strongly agree), with a higher total score indicating stronger perception of social support (Zimet et al., 1990). The Cronbach's α was 0.94 in this sample.

Coping style is defined as one's cognitive and behavioral effort to manage the internal and external demands of stressful events (Folkman, 2010). The Simplified Coping Style Questionnaire (SCSQ) was used to assess participants' coping styles. Two factors (positive coping [12 items] and negative coping [8 items]) showed good reliability and validity in previous studies (Li et al., 2014; Xie, 1998). In the current sample, Cronbach's alpha for total scale, positive coping and negative coping subscales were acceptable (0.87, 0.91 and 0.78, respectively).

2.3. Statistical analysis

Descriptive statistics of depression and anxiety using SPSS23.0, and paired sample T tests and repeated measures were used to examine the differences in depression and anxiety between Time1 and Time3. A Latent Growth Mixture Modelling (LGMM) (Muthén and Muthén, 2012) was conducted using Mplus 7.30 to identify depressive/anxiety symptoms trajectories across three timepoints. First, we analyzed whether there was a heterogeneous latent category in the developmental trajectory of adolescents' depressive/ anxiety symptoms. Starting from the initial model (assuming only one category in all samples), the number of categories in the model was gradually increased until the model that fitted the data best was found. Corresponding indicators were set as follows: Akaike Information Criteria (AIC), Bayesian Information Criterion (BIC), sample size adjusted BIC (a-BIC), Entropy value, Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR-LRT) and Bootstrap Likelihood Ratio Test (BLRT). In general, lower AIC, BIC, a-BIC values, higher Entropy value and a significant VLMR-LRT and BLRT were indicative of a better fit of the model to the data. In addition, only categories with no less than 5% of the total number of participants would be considered (Lo, 2005).

Moreover, to investigate the predictors of changes in depressive/ anxiety symptoms, we conducted two logistic regressions to calculate odds ratios (ORs) and 95% confidence intervals (95% CI), in order to compare symptom variations between different developmental trajectories of depressive/ anxiety symptoms. All socio-demographic variables

and psychological variables were considered as covariates, while perceived social support, positive/ negative coping was recoded into three categories, with low and high categories defined by the 27th and 73rd percentile. Two-sided p -value < 0.05 was considered statistically significant.

3. Results

3.1. Sample characteristics

Data of 2352 students living in the community with confirmed cases of COVID-19, was extracted from the overall three-wave longitudinal datasets. The age of current sample ranged from 16 to 25 years old, with a mean age of 20.01 (SE=1.76) years. Other socio-demographic characteristics were summarized in Table 1.

3.2. Prevalence of depressive/ anxiety symptoms at three points

Results showed that there was significant increase in both PHQ-9 ($t=-9.46, p<0.001$) and GAD-7 ($t=-6.81, p<0.001$) scores from Time 1 to Time 3, with the mean and standard deviation of PHQ-9 and GAD-7 shown in Fig. 2A. This result suggested that overall severity of depressive/ anxiety symptoms has increased. Prevalence of depression and anxiety were respectively 29.8% and 16.2% at Time 1, which subsequently increased to 40.3% and 23.7% at Time 3 respectively ($F = 98.86$ and 62.83 , all $p<0.001$) (see Fig. 2B). Measures score of Class 1 and Class 2 both were statistically significant between times 1 and 3 (Depression: t (Class1) = $-15.99, p<0.001$, t (Class 2) = $14.00, p<0.001$; Anxiety: t (Class1) = $-13.48, p<0.001$, t (Class 2) = $7.66, p<0.001$).

3.3. Trajectories of depressive/ anxiety symptoms

Fit indices of three-class models were shown in Table 2. For depression, the 2–3 class models showed relatively good fit to the data, as indicated by the lower AIC and BIC values and higher entropy values. However, some categories in the 3-class models were found to consist of less than 5% of the total population. Thus, the 2-class model was selected as the optimal model. As shown in Fig. 3A, there are two trajectories of depressive symptoms: students in Class 1 experienced high level of depressive symptoms at Time 1, with considerable decrement over time (intercept = 14.41, $p<0.001$; slope = $-2.63, p<0.001$). Students in Class 2 experienced lower levels depressive symptoms at three timepoints compared to those in Class 1. However, there is a slight upward tendency in depressive symptoms over time (intercept = 3.79,

Table 1

Participant sociodemographic characteristics ($N = 2352$).

Variables		N(%)
Gender	Male	582(24.7)
	Female	1770(75.3)
Grade	Freshman	888(37.8)
	Sophomore	676(28.7)
	Junior	461(19.6)
	Senior	177(7.5)
Residence location	Postgraduate	150(6.4)
	Rural	1172(49.8)
	Urban	1180(50.2)
Ethnicity	Han [♠]	2303(97.9)
	Others	49(2.1)
Only single child status	Yes	663(28.2)
	No	1689(71.8)
History of physical illness	Yes	15(0.6)
	No	2337(99.4)
History of mental illness	Yes	37(1.6)
	No	2315(98.4)
Age (years)	M(SD)	20.01(1.76)

Note: [♠] Ethnicity Han is the ethnic majority in China; M=mean score; SD=standard deviation.

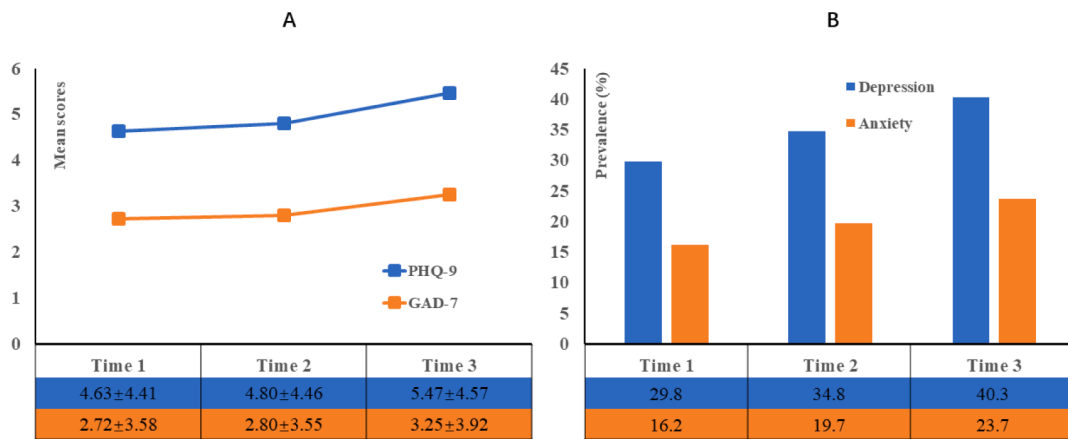


Fig. 2. The change of depression and anxiety in three time points. Note: (A) is the mean scores of PHQ-9 and GAD-7 ($M\pm SD$) at three timepoints; (B) is comparison of the prevalence of depression and anxiety (both cut-off value ≥ 7) at three timepoints.

Table 2
Goodness of fit statistics for each class solution.

	Model	AIC	BIC	a-BIC	Entropy	VLMR-LRT (p)	BLRT (p)	Smallest Class (%)
PHQ-9	1 C	38,694.36	38,740.46	38,715.04				
	2 C	38,319.45	38,382.84	38,347.89	0.91	<0.001	<0.001	6.7
	3 C	38,146.20	38,226.88	38,182.40	0.91	0.003	<0.001	3.1
GAD-7	1 C	37,108.32	37,154.42	37,129.00				
	2 C	36,056.52	36,119.91	36,084.96	0.82	<0.001	<0.001	15.4
	3 C	35,242.89	35,323.57	35,279.09	0.94	<0.001	<0.001	3.8

Note: Model with the best fit is shown in bold. AIC = Akaike information criterion; BIC = Bayesian information criterion; a-BIC = sample size-adjusted Bayesian information criterion; VLMR-LRT = Vuong-Lo-Mendell-Rubin likelihood ratio test; BLRT = bootstrapped likelihood ratio test.

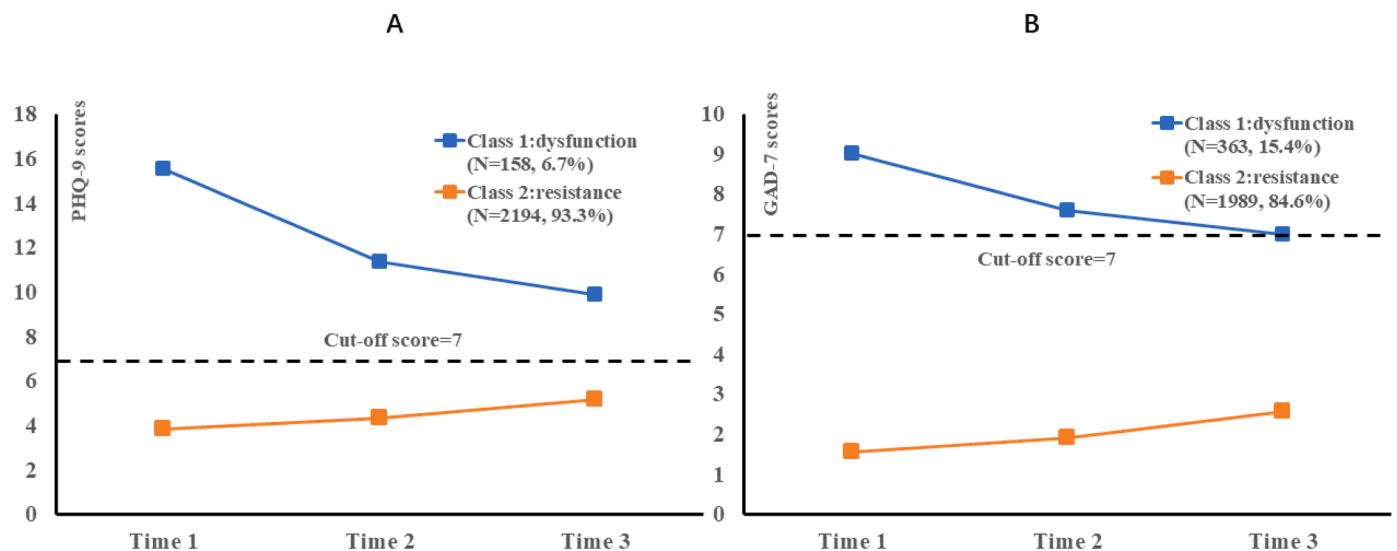


Fig. 3. Two types of trajectories. Note: Fig. 3A is the trajectory for depressive symptoms; Fig. 3B is the trajectory for anxiety symptoms.

$p < 0.001$; slope = 0.66, $p < 0.001$).

For the same reason as stated above, the two-class model was also selected for anxiety. Fig. 3B showed the two trajectories of anxiety: the largest group (Class 2: 84.6%) started with a low level of anxiety and then slight increasing trajectory (intercept=1.56, $p < 0.001$; slope=0.49, $p < 0.001$), and 15.4% (Class 1) had a high level and rapid decreasing trajectory (intercept=8.54, $p < 0.001$; slope=-0.97, $p = 0.001$).

In addition, the depressive and anxiety symptoms of Class1 have reached the clinical level of demarcation standards (cut-off score=7) at

all three time points, while Class2 have always been below the cutoff. Therefore, we identified Class 1 as the Dysfunction group, while Class 2 as the Resistance group.

3.4. Predictors of depressive/ anxiety symptoms trajectory membership

As shown as Table 3, we set the Class2 (Resistance group) as the referent group in binary logistic regressions. For depression, the likelihood of developing symptoms in Class 1(dysfunction group) would

Table 3
Binary logistic regressions for predictors of trajectory.

	Depressive symptoms		Anxiety symptoms	
	B (SE)	OR (95%CI)	B (SE)	OR (95%CI)
Gender				
Male	Ref		Ref	
Female	0.72 (0.23)**	2.05 (1.32,3.22)	0.50 (0.15)**	1.66 (1.23,2.22)
Grade				
Freshman	Ref		Ref	
Sophomore	-0.27 (0.23)	0.77 (0.49,1.21)	0.21(0.16)	1.24 (0.91,1.67)
Junior	0.34(0.23)	1.40 (0.89,2.21)	0.64(0.17)	1.89 (1.36,2.63)
Senior	0.82 (0.30)**	2.28 (1.27,4.07)	1.33(0.21)	3.79 (2.49,5.76)
Postgraduate	0.59(0.35)	1.80 (0.91,3.56)	0.83(0.13)	2.30 (1.40,3.79)
Residence location				
Rural	Ref		Ref	
Urban	0.20(0.18)	1.22 (0.85,1.75)	0.47(0.13)	1.56 (1.22,2.01)
Ethnicity				
Han	Ref		Ref	
Others	0.38(0.52)	1.46 (0.53,4.01)	-0.08 (0.42)	0.92 (0.41,2.08)
Only single child status				
No	Ref		Ref	
Yes	0.39(0.20)	1.48 (1.01,2.18)	-0.06 (0.14)	0.99 (0.75,1.32)
History of physical illness				
No	Ref		Ref	
Yes	0.30(0.81)	1.28 (0.36,6.35)	-0.21 (0.70)	0.82 (0.21,3.21)
History of mental illness				
No	Ref		Ref	
Yes	0.87(0.46)	2.39 (1.08,5.87)	0.85(0.38)	2.34 (1.11,4.95)
Perceived social support at Time 1				
Low	Ref		Ref	
Medium	-0.58 (0.19)**	0.56 (0.38,0.82)	-0.58 (0.14) ***	0.56 (0.43,0.74)
High	-1.60 (0.32)***	0.20 (0.11,0.38)	-1.31 (0.20) ***	0.27 (0.19,0.41)
Positive coping at Time 1				
Low	Ref		Ref	
Medium	-0.89 (0.21)***	0.41 (0.27,0.61)	-0.55 (0.14) ***	0.58 (0.44,0.77)
High	-0.97 (0.29)**	0.38 (0.21,0.67)	-0.91 (0.20) ***	0.40 (0.27,0.60)
Negative coping at Time 1				
Low	Ref		Ref	
Medium	0.51(0.23) [†]	1.66 (1.06,2.60)	0.62(0.16)	1.85 (1.37,2.50)
High	1.51(0.24)	4.46 (2.81,7.26)	1.37(0.17)	3.93 (2.81,5.50)

Note: both Class 2 (Resistance group) as the reference; OR= odds ratio; CI= confidence interval; [†]p<0.05, **p<0.01, *** p<0.001.

increase if the adolescents were females (OR = 2.05, 95% CI = 1.32–3.22), senior (OR = 2.28, 95% CI = 1.27–4.07), only single child status (OR = 1.48, 95% CI = 1.01–2.18), have a history of mental illness (OR = 2.39, 95% CI = 1.08–5.87), acquired less perceived social support (OR for medium v. low = 0.56, 95% CI = 0.38–0.82; OR for high v. low = 0.38, 95% CI = 0.11–0.38), adopted less positive coping (OR for medium v. low = 0.41, 95% CI = 0.27–0.61; OR for high v. low = 0.38, 95% CI = 0.21–0.67) or more negative coping (OR for medium v. low = 1.66, 95% CI = 1.06–2.60; OR for high v. low = 4.46, 95% CI = 2.81–7.26).

For anxiety, the likelihood of developing symptoms in Class 1 (dysfunction group) among participants who were female gender (OR = 1.66, 95% CI = 1.23–2.22), junior (OR = 1.89, 95% CI = 1.36–2.63), senior (OR = 3.79, 95% CI = 2.49–5.76), and postgraduate (OR = 2.30,

95% CI = 1.40–3.79) students, living in urban environment (OR = 1.56, 95% CI = 1.22–2.01), and have a history of mental illness (OR = 2.34, 95% CI = 1.11–4.95). Compared with low level, medium and high levels of perceived social support (OR for medium v. low = 0.56, 95% CI = 0.43–0.74; OR for high v. low = 0.27, 95% CI = 0.19–0.41) and positive coping (OR for medium v. low = 0.58, 95% CI = 0.44–0.77; OR for high v. low = 0.40, 95% CI = 0.27–0.60) are all protective factors against anxiety, while negative coping (OR for medium v. low=1.85, 95% CI = 1.37–2.50; OR for high v. low = 3.93, 95% CI = 2.81–5.50) consists of a risk factor.

4. Discussion

To our knowledge, the present study is the first longitudinal research to investigate the heterogeneous trajectories and predictors of psychological symptoms among adolescents who lived in communities with confirmed cases of COVID-19. Our findings suggested that the overall severity of depressive/ anxiety symptoms has increased among adolescents during the quarantine period. Two trajectories of depressive and anxiety symptoms were identified, namely Resistance trajectory and Dysfunction trajectory. Gender, grade, residence location, single child status, history of mental illness, social support and coping styles were shown to be significant predictors of distinct trajectories.

In this sample, the prevalence of depression and anxiety during the outbreak phase of COVID 19 (Time 1) were 29.8% and 16.2%, respectively, which increased to 40.3% and 23.7% after approximately four months. In a previous study that adopted the same screening scales to assess Chinese adolescents regardless the status of confirmed cases in their community, the prevalence of probable depressive (21.6% to 26.3%) and anxiety symptoms (11.4% to 14.7%) has increased from the COVID-19 outbreak to the initial remission (Li et al., 2021). Synthesizing with these findings, we proposed two main observations. First, the prevalence of depression and anxiety in adolescents living in communities with confirmed cases of COVID-19 was higher than the general adolescents' population (Li et al., 2021). One cross-sectional survey of a large sample also supported our results, suggesting adolescents who lived in communities with confirmed cases were 1.55–1.59 times more likely than other students to develop depressive and anxiety symptoms (Ma et al., 2020). Second, these adolescents' overall psychological distress became worse with the pandemic lockdown. As suggested by other studies, long-term home-isolation may increase the risk of mental health conditions for adolescents. It might be explained by the chronic stress associated with unexpected changes in living patterns (i.e., delay in returning to school, long-term home quarantine, and confinement for social distancing), which led to a host of physical and mental health problems (Majumdar et al., 2020).

Among adolescents living in communities with confirmed cases of COVID-19, depressive and anxiety symptoms showed two different types of developmental trajectories. Specifically, a small number of adolescents (Class1: dysfunction group) exhibited high levels of depressive and anxiety symptoms throughout the pandemic. Among adolescents in dysfunction group, the depression and anxiety level of were significantly higher during outbreak phase (Time 1) than initial remission phase (Time 2) and control phase (Time 3). This finding indicated that the outbreak of the COVID-19 pandemic has had a more negative mental health impact individuals compared to the subsequent phases. In the months after the COVID-19 outbreak, the Chinese government took a number of measures to reduce the threat to people's lives from pandemic. For example, the strict isolation system, requiring masks to be worn in public, and taking public transportation with a health code have greatly reduced the spread of the epidemic from person to person. Meanwhile, with the advancement of medical technology, the recovery rate of COVID-19 confirmed patients has been greatly improved, as well as the mortality rate has been greatly reduced. In addition, the government informs the masses of the latest pandemic situation in a timely manner through the media every day, which can help people

understands the current situation of the COVID-19 at the first time, and increase people's confidence in the control of the pandemic. However, although the severity of their symptoms have been decreasing with time in this group, their depression and anxiety scores remained above the clinical level (PHQ-9 or GAD-7 ≥ 7) across 3 time points. On the other hand, the majority of adolescents (Resistance group) showed good adaptability by reporting low level of depressive and anxiety symptoms at the pandemic outbreak. Although as the duration of home isolation extended, their depressive and anxiety symptoms showed a slight increase, however remaining below clinical cut-off. This may be detrimental to adolescent mental health due to loss of household income, restricted academic activities, reduced social communication after pandemic lockdown (Wang et al., 2021). This is also evidence in prior studies, which indicated that the home quarantine was positively associated with depression and anxiety (Shi et al., 2020; Wang et al., 2020c), as it reduced interpersonal communication, people's feelings of loneliness increased (Ge et al., 2017).

This study found demographic characteristics including gender, grade, residence location, only single child status and history of mental illness to be significant predictors of psychological symptoms. Female gender was associated with an elevated level of risk of being in the dysfunction group. Much literature has also identified female gender as a risk factor for depression and anxiety in general and especially during COVID-19 (Wang et al., 2020b; Zhao et al., 2020). Our data revealed that senior graduate students were more likely to report depressive and anxiety symptoms than their junior and postgraduate peers. Similar to other studies (Li et al., 2021; Ma et al., 2020), greater stress from graduation- and employment-related concerns during the quarantine period experienced by senior students might explain this result. Furthermore, our study showed that being single child was susceptible to experience depressive symptoms. Previous studies also reported that sibling relationship was a protective factor for adolescents' mental health (Prime et al., 2020). Chen and her colleagues conducted a three-cities survey to understand this phenomenon. They concluded that being the single child of the household may increase adolescents' sense of isolation and of anxiety from parents who were perceived to be more overly protective (Chen et al., 2020). In addition, in line with previous studies, students living in urban areas were more likely to report greater anxiety symptoms compared to their rural peers (Ozdin and Bayrak, 2020). A possible explanation to this result lied in the fact that urban communities were more densely populated and posed higher risk of infection, which directly increased residents' anxiety level. Our study was also consistent with previous COVID-19 studies (Goularte et al., 2021; McCracken et al., 2020; Ozdin and Bayrak, 2020), in that high incidence of depression and anxiety was found among adolescents with previous histories of mental illness.

Meanwhile, we further investigated some psychological factors of interest and examined their impact on mental health among adolescents living in communities with confirmed cases of COVID-19 during the quarantine period. In line with previous studies (Li et al., 2021; Ma et al., 2020; Zhang et al., 2020), our data further confirmed that having greater levels of perceived social support was a protective factor for adolescents' overall mental health. These findings pinpointed the importance of social support in facilitating adolescents' positive adaptation to public health emergencies (Bai et al., 2005). Cao et al. have found that social support was negatively correlated with the adolescents' anxiety during COVID-19. The same study also indicated that social support not only reduces the psychological stress during the pandemic but also changed the attitude regarding help-seeking behaviors in public (Cao et al., 2020). Previous studies on SARS also found that a high level of social support also helped individuals to enhance self-care and self-efficacy, thus promoting good psychological adjustment in the face of the public health crisis (Mak et al., 2009). Furthermore, our study evidenced the importance of coping skills in predicting depression and anxiety, which was consistent with related previous studies (Fu et al., 2020; Lew et al., 2019). Specifically, positive coping was found to improve mental health

resistance. In contrast to the protective effect of positive coping, negative coping was a significant risk factor for depression and anxiety. These results highlighted the crucial role of integrating coping trainings into post-pandemic psychological interventions. More positive coping and less negative coping were also found to increase the likelihood of resilience in the face of psychological distress (Fan et al., 2015; Zheng et al., 2012).

Accordingly, these factors above should also be taken into consideration for psychosocial intervention during the COVID-19. Evidence-based studies have shown the effectiveness of cognitive behavior therapy (CBT) in reducing the psychological impact of the pandemic (Ho et al., 2020a). Internet CBT (I-CBT) also owns the great benefit of cost effectiveness (Zhang et al., 2017), as it has been widely used in the treatment of mental health problems such as insomnia symptoms (Soh et al., 2020).

Despite all the relevant findings, some limitations of our study should be considered. First, the current sample was selected from adolescents living in the community with confirmed cases of COVID-19 during the outbreak period (Time 1). However, the potential changes in the infection status at Time 2 and Time 3 in the communities where the adolescents were from might impose a confounding effect. Meanwhile, variability of the infection prevention measures across China might also impact participants' psychiatric symptoms. Moreover, it was also challenging to obtain an accurate total number of confirmed cases in each community, which might further lead to bias when analyzing the mental health outcomes of our sample. In our study, we were unable to obtain the pre-pandemic levels of depression and anxiety among these participants, which also limited understanding of the impact of the outbreak on participants' psychological distress. Furthermore, as social support and coping styles were only measured at Time 1, we were also unable to learn about its evolution during the lockdown. Finally, the confounding factors caused by measurements at different time points might bring some bias to the results, such as relatives or friends being infected with COVID-19, seasonality, and life events during pandemic lockdown. Finally, our participants were vast majority sampled from Guangdong Province, which was a moderate-risk area by the time of our sample collection. It is uncertain whether our findings could be generalized to all adolescents over the country, especially those living in high-risk areas.

5. Conclusion

In conclusion, our study showed two developmental trajectories of depressive and anxiety symptoms among adolescents with heightened risk of contracting COVID-19 during the quarantine period, with confirmed cases in their community. The most common trajectory was identified as Resistance Group, and the other was characterized as Dysfunction Group. Female gender, senior grade, living in urban, single child status and history of mental illness were all found to be significant predictors of persistent clinical level of psychological symptoms. More social support and higher level of positive coping were protective factors for mental health whereas higher level of negative coping negatively predicted among adolescents. Therefore, these factors should be taken into consideration for designing effective psychosocial intervention during the COVID-19 pandemic.

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CRedit authorship contribution statement

Dongfang Wang: Methodology, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **Jingbo Zhao:** Resources, Investigation, Writing – review & editing. **Shuyi Zhai:** Writing – review & editing. **Huilin Chen:** Writing – review & editing. **Xianchen Liu:** Supervision, Project administration, Writing – review & editing. **Fang Fan:** Supervision, Resources, Project administration, Funding acquisition, Writing – review & editing.

Declaration of Competing Interest

The authors declare no conflicts of interest regarding data and materials presented in this paper.

Ethics approval and consent to participate

This study was approved by the Human Research Ethics Committees of South China Normal University (Ethics_No._SCNU-PSY-2020-01-001).

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