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Behavioral problems of pediatric patients recovered from COVID-19 in Wuhan, China

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) is profoundly affecting lives around the globe. Previous studies on COVID-19 mainly focused on epidemiological, clinical, and radiological features of patients with confirmed infection. Little attention has been paid to the follow-up of recovered patients. As a vulnerable population to adverse events, the health status of the COVID-19 recovered pediatric patients is of great concern. We aimed to investigate the prevalence of behavioral problems among pediatric patients recovered from the COVID-19 in Wuhan, China.

Methods: A total of 122 children who were suspected or confirmed COVID-19 cases and hospitalized for treatment were enrolled in the study between April 2020 and May 2020 in Wuhan, China. We collected related information about hospitalization and discharge of the children and emotional symptoms of their parents through electronic medical records and questionnaire. The behavioral problems of children were examined by applying the parent-reported the Strengths and Difficulties Questionnaire (SDQ).

Results: The participant children were discharged from hospital after about two months. Among them, 76 (62%) were boys, and the mean age was 6.71 years old. The highest prevalence of behavioral problems among pediatric children with COVID-19 was for prosocial behavior (15%), followed by total difficulties (13%), emotional symptoms (11%), hyperactivity (10%), conduct problems (9%), and peer problems (1%). With regarding to their parents, 26% reported having symptoms of anxiety and 23% as having symptoms of depression. The scores of SDQ were higher in those children whose parents have emotional problems compared to parents without.

Conclusion: Long-term follow up studies on the psychological and behavioral problems of COVID-19 recovered children and their parents are warranted.

1. Introduction

In December 2019, an outbreak of the coronavirus disease 2019 (COVID-19) was first reported in Wuhan, Hubei province, China. As of 18 June 2020, the COVID-19 pandemic has been responsible for more than 8,061,550 infections worldwide, with a mortality rate of almost 5.5% (WHO, 2020). People of all ages are susceptible to COVID-19 infection, including children. According to the Chinese Center for Disease Control and Prevention, approximately 1% of pediatric cases were

younger than 10 years (Wu & McGoogan, 2020). Children were less susceptible to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and most pediatric cases appeared to have milder clinical symptoms, and lower mortality rates (Dong et al., 2020; National Institute of infectious diseases, 2020; Su et al., 2020; Tian et al., 2020).

The potential effect of the COVID-19 outbreak on recovered pediatric patients may be more important but is easily neglected issue and must be made a priority. In response to the transmission of the COVID-19

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outbreak, the Chinese Government has implemented strict domestic quarantine policies. Children infected with or suspected of being infected with COVID-19 will be quarantined for professional treatment in the local hospital, and some may be separated from their caregivers (Beck et al., 2021; Cui et al., 2020; Efendi et al., 2022; Jain et al., 2020; Taylor et al., 2021; USCDC, 2020, 2022). Stressors such as temporary separation from their caregivers, social isolation, loneliness and fears of progression of the disease might push them into a state of crisis, which will not disappear immediately after discharge (Golberstein et al., 2020; Liu, Bao, et al., 2020). In addition, pediatric cases were generally characterized as a familial cluster and parents of hospitalized children are exposed, as never before, to enormous stress and psychological distress (Choi et al., 2020). The parental psychological response was found to be highly associated with the well-being of the children (Li et al., 2004). Moreover, in some communities, stigmatization of infected children and families may occur. In view of this, the disease among pediatric patients should not be taken lightly even after discharge. Also, previous studies have shown that behavioral problems were commonly seen among children after the disaster (Fujiwara et al., 2014; McDermott & Cobham, 2012; Miki et al., 2019).

Childhood is a special time of vulnerability but also of opportunity (Clark et al., 2020). The immediate research priorities are to monitor behavioral performance among pediatric patients after discharge to provide evidence for informing early childhood interventions, particularly in children who are exposed to a high risk for behavioral problems. Therefore, we conducted the present study by applying the Strengths and Difficulties Questionnaire (SDQ) to determine the behavioral effect of the COVID-19 epidemic on young recovered pediatric patients aged 3–9 years about two months after discharge in Wuhan, China.

2. Methods

2.1. Study population

The present study was conducted between April and May 2020 at Wuhan Children's Hospital, the only center assigned by the central government for treating children infected with COVID-19 in Wuhan. About two months after discharge, children who were suspected or confirmed COVID-19 cases and hospitalized in the study hospital for treatment were invited to participate in the study. There were two recruitment approaches: when children came to the hospital for the follow-up visit, they were invited to participate in and complete the questionnaire survey in the hospital; and for those children who did not return to the hospital for follow-up, an electronic questionnaire was sent through the official platform of the hospital to invite them to participate in the survey. The diagnosis of COVID-19 infection was made according to the guidelines for diagnosis and management of COVID-19 (in Chinese) released by the National Health Commission of China (the Fifth and Six Editions). A clinically-diagnosed case is defined as suspected patients with typical pneumonia manifestation (only in Hubei province) (National Health Commission of People's Republic of China, 2020). Some children were admitted to hospital as suspected cases but were negative on multiple nucleic acid tests and thus were excluded as cases. All subjects signed an electronic informed consent before answering the online questionnaire surveys. The research protocol was approved by the ethics committees of Wuhan Children's Hospital, Tongji Medical College Huazhong University of Science & Technology (number: 2020R003-E01, the approval date: 9 March 2020).

2.2. Data collection

An Internet-based questionnaire survey was completed by parents or guardians to collect the children's information on clinical characteristics (e.g. the time from symptom onset to hospitalization), communication with parents during hospitalization (frequency and average time), physical activity during discharge (intensity, the frequency and average

time), behavioral problems of the children and emotional symptoms of the parents (anxiety and depression). We also extracted the basic characteristics (gender, age, diagnosis of cases, hospitalization time, discharge time) from the electronic medical records. The children's behavioral problems were assessed applying the parent-reported SDQ. The parent's emotional symptoms of anxiety and depression were measured using the Generalized Anxiety Disorder-7 Questionnaire (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9).

The SDQ is a well-validated screening questionnaire for evaluating behavioral problems in childhood (Goodman, 1997). It has 25 items and respondents are scored according to their behavior over the previous six months (score 0–2: from “not true” to “certainly true”). The five subscales (emotional symptoms, conduct problems, hyperactivity-inattention, peer problems and prosocial behaviors), except for prosocial behaviors, are added together to generate a total difficulty score. The SDQ has been introduced and formally adapted to the Chinese language. The parent-reported version of the SDQ has been confirmed as having good psychometric properties and thus was used in the present study (Goodman et al., 2000). The higher scores of the scale indicates more serious behavioral problems (apart for prosocial behavior). The cutoff scores recommended for identifying a child at high risk of behavioral problems are as follows: conduct problems >3, hyperactivity problems >7, peer problems >5, prosocial behaviors <5, emotional symptoms >4 and total difficulties >16 (Du et al., 2008).

The GAD-7 is a seven-item self-report scale for assessing the severity of generalized anxiety disorders in the clinic (Kroenke et al., 2007). Scores on the GAD-7 range from 0 to 21, with a score of 5 representing a positive anxiety symptom. The PHQ-9 is a nine-item self-reported scale that is used to screen for depressive symptoms (Spitzer et al., 1999). Responses are scored on a four-point Likert-type scale from “0” (not at all) to “3” (nearly every day). The PHQ-9 scores of 5 indicates a positive depressive symptom (Kroenke et al., 2001).

2.3. Statistical analysis

In the study, we assessed the distribution of general characteristics and then examined the prevalence of behavioral problems among the children. Categorical variables were expressed as number (%), and continuous variables as mean [standard deviation (SD)]. The independent sample *t*-test was used to determine the differences between independent groups in terms of continuous outcomes, whereas the χ^2 test was used to determine categorical outcomes. We also calculated effect sizes (Cohen's *d*) to describe the standardized mean difference of an effect. Cohen's *d* is directly related to the *t*-test as follows: small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$) (Lakens, 2013). Statistical analysis was performed in SPSS 22.0 (SPSS Inc., Chicago, IL, USA). A $P < 0.05$ (two-tailed) was considered to be statistically significant.

3. Results

A total of 270 suspected or confirmed COVID-19 pediatric cases aged 3–9 years were hospitalized in the study hospital for treatment. Among them, 121 children came to the hospital for follow-up, and 149 children did not attend follow-up. There were 81 children who came to the hospital for follow-up and 41 children who did not come to the hospital for follow-up included in the study. Finally, 122 participants were recruited for analysis. Table 1 shows the general characteristics of the pediatric cases in the study that were followed up/not followed up and included/excluded. Compared with the pediatric patients without follow-up, the children who came to the study hospital for follow-up were older and included more confirmed cases by the nucleic acid polymerase chain reaction (PCR) test. Included and excluded children were similar in term of their demographic and clinical characteristics (all $P < 0.05$). Among the included participants, 76 (62%) were boys, and the mean age were 6.71 years. Most participants (42%) were PCR-diagnosed cases and the average hospitalization time was 11.89 days.

Table 1

The general characteristics of the pediatric cases that were followed up, not followed up, included and excluded in the study.

Variables	All populations [no. (%)]	With follow-up [no. (%)]	Without follow-up [no. (%)]	<i>P</i>	Included [no. (%)]	Excluded [no. (%)]	<i>P</i>
Gender				0.43 ^a			0.25 ^a
Boy	158 (59)	74 (61)	84 (56)		76 (62)	82 (55)	
Girl	112 (41)	47 (39)	65 (44)		46 (38)	66 (45)	
Age (years) ^c	6.49 (2.08)	6.93 (2.02)	6.14 (2.06)	0.002 ^b	6.71 (2.08)	6.32 (2.06)	0.13 ^b
Age (years)				0.005 ^a			0.10 ^a
3–5	112 (41)	39 (32)	73 (49)		44 (36)	68 (46)	
6–9	158 (59)	82 (68)	76 (51)		78 (64)	80 (54)	
Cases				<0.001 ^a			0.18 ^a
Excluded cases after PCR-diagnosis	77 (28)	23 (19)	54 (36)		28 (23)	49 (33)	
Clinically-diagnosed cases	88 (33)	32 (26)	56 (38)		43 (35)	45 (30)	
PCR-diagnosed cases	105 (39)	66 (55)	39 (26)		51 (42)	54 (37)	
Hospitalization time (days) ^c	11.89 (6.71)	11.60 (5.02)	12.13 (7.83)	0.52 ^b	11.89 (5.86)	11.90 (7.36)	0.99 ^b
Hospitalization time (days)				0.88 ^a			0.82 ^a
≤10	152 (56)	69 (57)	83 (56)		68 (56)	84 (57)	
>10	117 (44)	52 (43)	65 (43)		54 (44)	63 (42)	
Missing	1 (0)	0	1 (1)		0	1 (1)	

Abbreviations: PCR, Polymerase Chain Reaction.

^a *P*-Values were derived using χ^2 test to examine the distribution of general characteristics between the children with the two groups.^b *P*-Values were derived using independent sample *t*-test to examine the distribution of general characteristics between the two groups.^c Expressed as mean (standard deviation).

3.1. Sociodemographic and clinical characteristics

Table 2 lists selected characteristics of the study children and their parents from the questionnaires, approximately 40% of which were completed by fathers. The prevalence of positive anxiety and depression symptoms in parents were 26% and 23%, respectively. The time from symptom onset to hospitalization was 3.62 days, on average, and the discharge time was 59.99 days. Around 40% of children were not exposed to suspected or confirmed COVID-19 cases before symptom onset. During hospitalization, the majority of parents talked with their children 1–3 times a day (28%), and 55% of them talked for less than 10 min each time. After returning home from hospital, children were likely to take slight physical exercise (58%), with 41% of them exercising 1–3 times a week.

3.2. Behavioral problems of the children infected with COVID-19

The scores of the SDQ and the prevalence of behavioral problems among the children infected with COVID-19 are shown in Table 3. The mean score of the SDQ was 2.21 for emotional symptoms, 1.87 for conduct problems, 4.39 for hyperactivity, 2.54 for peer problems, 6.25 for prosocial behavior and 11.02 for total difficulties. The highest prevalence of behavioral problems among pediatric children with COVID-19 was for prosocial behavior (15%), followed by total difficulties (13%), emotional symptoms (11%), hyperactivity (10%), conduct problems (9%), and peer problems (1%).

3.3. Psychological and behavioral problems of parents and COVID-19 infected children

Figs. 1 and 2 present the scores of behavioral problems of children with COVID-19 among parents with and without positive mental symptoms. Compared with children of parents without anxious symptom, higher scores of emotional symptoms and total difficulties were observed in children with anxious symptom parents (anxious symptoms: mean 1.96 vs. 2.94, $P = 0.01$, Cohen's $d = 0.58$; total difficulties: mean 10.43 vs. 12.66, $P = 0.01$, Cohen's $d = 0.52$, respectively). Similarly, children who had depressive symptoms in their parents were likely to have much higher score of emotional symptoms (mean 1.96 vs. 3.07, $P = 0.02$; Cohen's $d = 0.66$), conduct problems (mean 1.74 vs. 2.29, $P = 0.04$; Cohen's $d = 0.45$), hyperactivity (mean, 4.14 vs. 5.25, $P = 0.02$; Cohen's $d = 0.52$) and total difficulties (mean 10.37 vs. 13.18, $P < 0.001$;

Cohen's $d = 0.66$) than children of parents without depressive symptoms.

The distribution of behavioral problems among the study characteristics is summarized in eTable A. No significant differences were found for the SDQ score in children with regard to the following variables: gender, age, communication with parents during hospitalization and physical activity during discharge (all $P < 0.05$).

4. Discussion

In the present study, we conducted an Internet-based cross-sectional study to assess the impact of the COVID-19 epidemic on the behavioral problems of recovered pediatric COVID-19 patients two months after discharge in Wuhan city, Hubei province, China. The prevalence of behavioral problems in pediatric patients was increased slightly, the highest of which was prosocial problems (15%), followed by total difficulties (13%), emotional symptoms (11%), hyperactivity (10%), and conduct problems (9%). With regarding to their parents' emotional problems, 26% of parents reported positive anxiety symptoms and 23% reported positive depressive symptoms. The behavioral problems of children with positive parents having anxiety and depressive symptoms were more than those of children with parents having no emotional symptoms.

Our analysis reveals that pediatric patients, despite apparent clinical recovery at discharge, had obvious behavioral problems when evaluated approximately two months later. Extensive research has examined the mental health burden in adults discharged from hospital with COVID-19 in China (Chen et al., 2020; Chen, Huang, et al., 2021; Chen, Ju, et al., 2021; Huang, Huang, et al., 2021; Huang, Xu, et al., 2021; Huang, Zhuang, et al., 2021; Ju et al., 2021; Liang et al., 2020; Liu, Bao, et al., 2020; Liu, Baumeister, et al., 2020; Putri et al., 2021; Qu et al., 2021; Tu et al., 2021; Wu, Chen, et al., 2020; Wu, Hu, et al., 2020; Xiong, Xu, et al., 2021; Xiong, Zhong, et al., 2021; Yuan et al., 2020), Italy (Mattioli et al., 2021; Tomasoni et al., 2021), Australia (Darley et al., 2021; Rass et al., 2021), Netherlands (de Graaf et al., 2021; Vlaker et al., 2021), the UK (Halpin et al., 2021; Zavala et al., 2021), France (Garrigues et al., 2020; Horn et al., 2021; Morin et al., 2021), Germany (Augustin et al., 2021; Daher et al., 2020), Iran (Khademi et al., 2021; Mirfazeli et al., 2022), Egypt (Kamal et al., 2021), Brazil (Damiano et al., 2022; Todt et al., 2021), the USA (Daugherty et al., 2021; Graham et al., 2021; Jovanoski et al., 2021; Martillo et al., 2021), and Korea (Chang & Park, 2020) (see details in e Table B), reporting substantial psychological

Table 2

The selected characteristics of the participants in the study.

Variables	No. (%)
Relationship between respondents and children	
Father	49 (40)
Mother	71 (58)
The others	2 (2)
Anxiety symptoms of parents	
No	90 (74)
Yes	32 (26)
Depressive symptoms of parents	
No	94 (77)
Yes	28 (23)
Time from symptom onset to hospitalization ^a	3.62 (5.92)
Time from symptom onset to hospitalization	
≤3	68 (56)
>3	37 (30)
Missing	17 (14)
Discharge time (days) ^a	59.99 (16.18)
Discharge time (days)	
≤60	58 (48)
>60	64 (52)
Number of patients exposed to confirmed or suspected COVID-19 before symptom onset	
0	49 (40)
1	34 (28)
2	20 (16)
>2	14 (12)
Missing	5 (4)
Frequency of phone conversations with children (per day)	
Rarely	23 (19)
<1 time	33 (27)
1–3 times	34 (28)
>3 times	32 (26)
Time for each phone conversations	
Less than 10 min	67 (55)
11–60 min	45 (37)
More than 60 min	10 (8)
Intensity of physical exercise after discharge	
No exercise	11 (9)
Slight	71 (58)
Moderate	40 (33)
Time for each physical exercise	
Less than 10 min	36 (30)
11–30 min	70 (57)
More than 30 min	16 (13)
Frequency of physical exercises	
Less than once a week	23 (19)
1–3 times a week	50 (41)
4–6 times a week	25 (20)
Every day	24 (20)
Days exercise more than 60 min (per week)	
0	47 (39)
1–3 days	49 (40)
More than 3 days	26 (21)

Abbreviations: COVID-19, Coronavirus disease 2019.

^a Expressed as mean (standard deviation).

distress in the first few months after infection. However, there is limited information available on pediatric patients. Liu and colleagues assessed children (aged 5–18 years) from Wuhan, China, who had been hospitalized with COVID-19 infection, and found significant symptoms of depression and anxiety in 15.8% and 31.6%, respectively (Liu, et al., 2021). A study from the UK reported that children with symptomatic COVID-19 had a slightly higher prevalence of ongoing symptoms than symptomatic controls (Zavala et al., 2021). This might be due to the relatively long COVID-19 isolation period, which prevents infected children from immediately returning home to their family. Furthermore, some patients may complain about psychological and/or somatoform disturbances after vaccination (Lutzen et al., 2017; McMurtry, 2020; Poddighe et al., 2014). Intervention with psychological distress may also help to prevent adverse psychological events related to vaccination in both children and adolescents.

Parents of COVID-19 patients might be at increased risk of

Table 3

The scores of SDQ and the prevalence of behavioral problems among the infected children with COVID-19.

	Mean (SD)	Negative symptoms [No. (%)]	Positive symptoms [No. (%)]
Emotional symptoms	2.21 (1.75)	108 (89)	14 (11)
Conduct Problems	1.87 (1.21)	111 (91)	11 (9)
Hyperactivity	4.39 (2.18)	110 (90)	12 (10)
Peer problems	2.54 (1.30)	121 (99)	1 (1)
Prosocial behavior	6.25 (1.99)	104 (85)	18 (15)
Total difficulties	11.02 (4.38)	106 (87)	16 (13)

Abbreviations: COVID-19, Coronavirus disease 2019; SD, standard deviation; SDQ, the Strengths and Difficulties Questionnaire.

experiencing psychological distress, with 26% and 23% suffering anxiety and depressive symptoms, respectively. Previous studies had already identified that relatives of patients hospitalized with COVID-19 might be equally affected. It is suggested that both isolated COVID-19 patients and their relatives might suffer from similarly high levels of anxiety and depressive symptoms during the initial stage of hospitalization (Dorman-Ilan et al., 2020). Based on the above-mentioned reasons, the prevalence of emotional problems among parents is still high, even when their infected children are discharged after about two months. These individuals might therefore require increased clinical attention tailored to their needs in order to prevent an adverse long-term psychological burden.

In addition, the more anxious and depressed the parents were, the more behavioral problems the children had. The link between parents' and children's post-disaster distress has been well established (Bonanno et al., 2010). Previous studies have used parental distress to predict a child's symptoms, such as posttraumatic stress disorder (PTSD), after a disaster (Chemtob et al., 2010; Furr et al., 2010). Childhood is the time when children are most dependent on their parents and families. Parents play an important role in equipping young children to understand and cope with a disaster (Cobham et al., 2016; Proctor et al., 2007). To further identify the potential risk factors for behavioral problems among pediatric patients, we have investigated related information on basic and clinical characteristics, communication with parents during hospitalization and physical activity during discharge. We found a downward trend in the SDQ scores for these the related factors, but no statistical significance, possibly due to the small sample size of the study.

Finally, we are aware of some limitations. As a cross-sectional design was applied in this study, some information (e.g. communication with parents during hospitalization) obtained from the questionnaire might introduce recall bias. In addition, potential influencing factors (e.g. socio-economic characteristics) may not be identified in the analysis, although we collected basic features and related information during hospitalization and discharge in the study. Furthermore, the follow-up period was relatively short and the study does not capture how problems evolve over time. Long-term follow-up would aid in further understanding of the progression of psychological well-being after discharge.

5. Conclusions

A considerable proportion of pediatric COVID-19 patients show symptoms of psychological and behavioral distress two months after hospital discharge, as well as their relatives. Therefore, the long-term follow-up studies should be established for monitoring and ascertaining the psychological and behavioral problems of specific vulnerable populations under pandemic conditions.

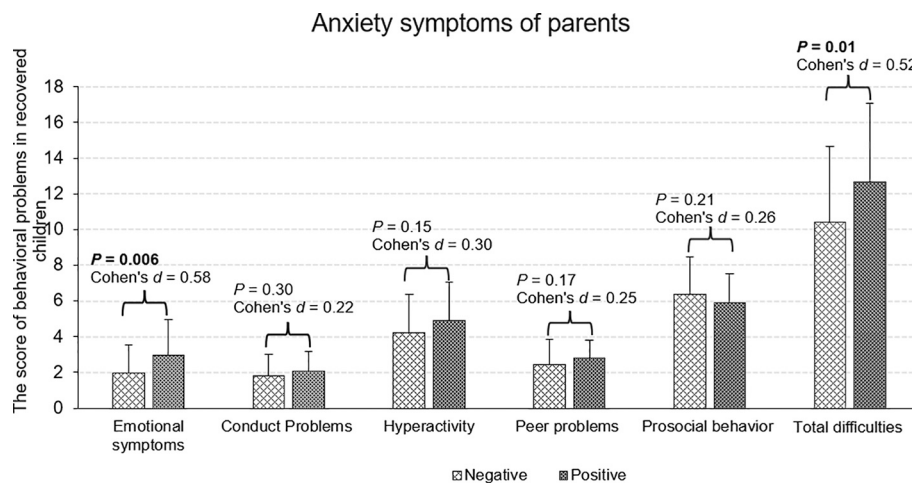


Fig. 1. The scores of behavioral problems of children with COVID-19 among parents with and without anxiety symptoms.

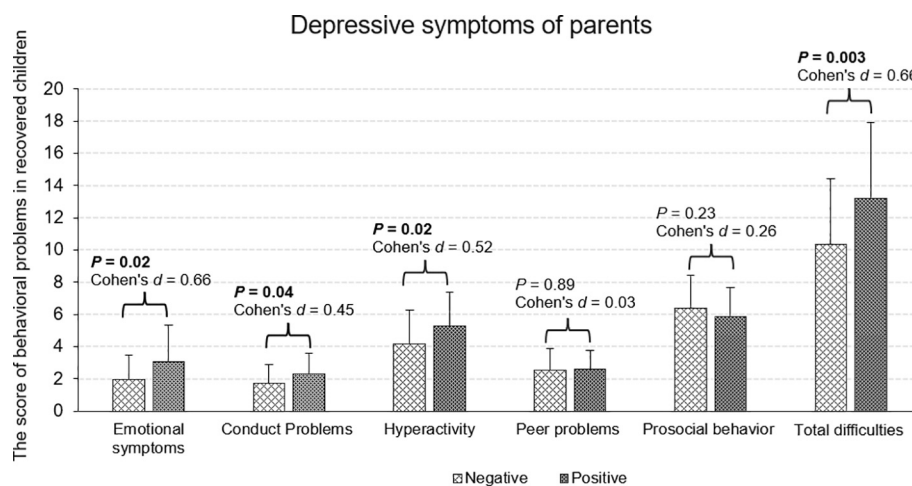


Fig. 2. The scores of behavioral problems of children with COVID-19 among parents with and without depression symptoms.

Authors' contribution

ZL, RS, and HX designed the work; HX, QL, HM, XC, ZX and HL collected primary data and analyzed the data; HX, QL, QX, XX, YZ, KZ and ZW interpreted the data; ZL, RS, HX and QL had drafted the work and substantively revised it. All authors read and approved the final manuscript.

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Declaration of competing interest

The authors have indicated they have no potential conflicts of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.actpsy.2022.103571>.

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