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Influence of parental attitudes and coping styles on mental health during online teaching in the COVID-19 pandemic

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During the COVID-19 pandemic, the online delivery model became the primary mode of education. With multiple pressures on society and families, mental health issues for parents have become particularly pronounced. Most of the current research has focused on the psychological state of education practitioners and children, with little attention to parents' mental health issues. Therefore, this study explored the attitudes and coping styles of parents who experienced the process of their children being taught online over a long period and the factors influencing their mental health. This cross-sectional study was conducted between November 2021 and January 2022, using an anonymous online questionnaire to survey 1500 parents with children aged 6–13 years. The Chinese versions of the Patient Health Questionnaire Depression Scale (PHQ-9), the Parenting Stress Scale (PSS), the General Mental Health Questionnaire (GHQ-12), and the Brief Coping Style Scale (SCSQ), and a related factors questionnaire were used to survey the subjects. The normal distribution of the data was examined using the Shapiro–Wilk method. A multivariate regression analysis was conducted to identify factors significantly associated with parental mental health during the COVID-19 pandemic. Only 30.24% of parents agreed with online classes during the pandemic, and 52.28% used positive coping methods during stressful situations. Multivariate regression models identified significant factors associated with parental mental health: parent's gender, child's grade level, perceived stress about online classes, whether the child has ADHD, positive or negative coping styles, and subjective attitudes of support for online classes or not. The results of the study suggest that as online classes become more socially acceptable, it is necessary to be concerned about the risk of mental illness for parents and develop policies and interventions, especially for parents who adopt negative coping styles and endorse online classes. The focus should be on the stress of online classes on parents, improving the acceptance of online classes and psychological well-being, regulating the way parents deal with their children, and targeting subgroups of children with ADHD symptoms during the COVID-19 pandemic.

Keywords Online delivery, Parenting stress, Coronavirus,, Coping styles, Parental mental health

Neonosis is a serious respiratory disease caused by infection with the novel coronavirus SARS-COV-2, known as COVID-19. Since 2019, COVID-19 has created a global pandemic, posing a significant threat to global public health¹. Although the case fatality rate of COVID-19 has been estimated at 2–3%, which is considerably lower than that of Severe Acute Respiratory Syndromes (SARS) (approximately 10%) and Middle East Respiratory Syndrome (MERS) (approximately 40%)^{2–4}, its impact has been profound. The virus has an extremely high transmission rate through the respiratory tract and close contact. As of 15 March 2020, COVID-19 has spread rapidly to 34 provinces and cities in China, while 144 countries/regions in five continents worldwide have reported cases

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of infection to varying degrees⁵. Thus, the COVID-19 pandemic in recent years has posed a significant challenge to the entire society and every individual's life.

With the global spread of COVID-19, education in China and worldwide is facing a considerable challenge. Anticipating the high transmission rate of the virus, the crowded nature of public places such as campuses, and the low immunity profile of adolescents, the Chinese government enacted a series of responses, of which the use of online learning became a typical result of the COVID-19 pandemic^{6,7}. While such initiatives have played a large part in preventing and controlling the pandemic, the impact on the parent and child side of the online delivery context is currently varied. Means et al. argue that online learning is an educational tool based on technological devices and the Internet in an era of rapid development⁸. Tallent-Runnels et al. are similarly optimistic that technological innovations and the continued growth of Internet accessibility can increase the motivation to learn online⁹. By contrast, however, Joshi et al. found that the pedagogical outcomes of online learning are controversial and that online learning directly contributes to the lack of face-to-face interaction between students and teachers¹⁰. Research has shown that effective online education requires high-quality means for designing and assessing online courses and that the operators, the teachers who deliver the courses online, are equally required in terms of proficiency in the use of Internet equipment, etc^{11,12}. Unfortunately, many educational institutions lack a careful design and development process for the transition of teaching models¹³, and the online education experience during the pandemic has suffered from varying degrees of skepticism and rejection¹⁴.

During the COVID-19 pandemic, the conflict between the educational format and the students translated in different ways and to varying degrees into multifaceted stress and family conflicts for parents. On the one hand, online instruction placed greater demands on the technology of connecting to the Internet, as a great challenge for many economically disadvantaged households, especially with the economic depression induced by the pandemic. Students from different family backgrounds faced different feedback on their online learning, even with the same willingness to learn. In particular, younger students^{15,16}, students from immigrant backgrounds¹⁷, and students from families with a low socioeconomic status¹⁸ encountered more difficulties with distance learning. At the same time, the prolonged online mode of delivery poses a risk of increased exposure of learners to screens, impacting young people's visual health. The lack of teacher and parental supervision is another challenge, especially for young learners. The disadvantaged, weaker learners, requiring more supervision and guidance from their elders, face significant difficulties in this learning environment. Beyond China, the pandemic and the closure of schools have profoundly affected the mental health of students worldwide¹⁹. Empirical studies in Bangladesh, China, France, Greece, the UK, and the USA have found that a large proportion of students suffer from varying degrees of mental disorders^{20–22}. Many students experiencing the online delivery model over a long period report suffering from depression, anxiety, distress, and even suicidal thoughts^{23,24}. Interestingly, this academic mental health problem of adolescents is, to some extent, transferred to their parents. Due to multiple issues, such as the inadaptability of the online mode of delivery and socioeconomic pressures, the academic burden of the children leads to different aspects of psychological feedback and coping for the parents.

Apart from the financial pressures on some families, parents and children in the context of their different formative years show very different attitudes and behavioral patterns toward the use and efficacy of electronic devices. This phenomenon has been particularly notable in online education during the COVID-19 pandemic. According to Soykan, parents emphasize the expected dangers of using technology for academic performance²⁵. The epidemic forced parents to take on an additional task: supervising children during class, especially at basic and primary levels. Research on emergency distance learning during the COVID-19 pandemic has shown reduced interactions between teachers and students²⁶, with the ability of students to learn independently and actively being crucial to students' academic performance²⁷. Hale, Troxel, and Buysse surveyed online teaching and concluded that parents were disappointed in helping their children focus and participate in virtual classrooms²⁸. The study reported emotional and behavioral problems (i.e., anxiety, irritability, and distraction) observed by parents in their children and adolescents due to the epidemic²⁹. These phenomena are particularly significant in adolescents with attention deficit hyperactivity disorder (ADHD). Some relevant studies have shown that adolescents with ADHD find it more difficult to adapt to the online teaching mode compared to their peers and often exhibit problems such as motivation problems and executive dysfunction³⁰. ADHD children face significant challenges in online learning environments, including attention, task organization, and completion difficulties. The lack of face-to-face supervision and structure can make it harder for them to adapt and participate in learning activities. Additionally, the demands for self-discipline and time management in online learning pose further obstacles for these children³¹. Parents often bear different levels of pressure and mental health problems due to the problems associated with electronic equipment, anxiety about performance under online learning, and comprehensive social pressure during the COVID-19 pandemic. Research has shown that parents have greater responsibility and participation in their children's learning in a distance learning environment than in regular classroom teaching³². This is a vicious circle of contradictions, wherein the various forms of pressure on parents may affect how students experience a new learning environment: the greater the pressure their parents feel, the more negative their views of distance learning become.

Under enormous social and economic pressure, the threat of COVID-19 infection, and the anxiety about children's academic performance, parents experience mental health problems to varying degrees, which impact their social development. Studies have shown that home isolation, economic hardship, despair, and loneliness during the COVID-19 pandemic also increased the risk of mental illness and suicide^{33,34}. Social isolation is usually closely related to physical and mental health issues³⁵. Such mental health problems often have an inseparable relationship with the parents' attitudes toward online teaching during the COVID-19 pandemic and the measures taken, which are often unavoidable. However, no scholars have yet reported on this phenomenon.

Therefore, this study investigated the parents' sociodemographic information and mental health scoring variables (depression level, parenting stress, general psychological state, and coping style) to analyze differences in parental mental health and their related factors under different coping styles and attitudes toward online

courses and explore how factors such as children's ADHD symptoms, parents' attitudes toward online courses, and parents' coping styles affect parents' mental health, in an attempt to provide effective guidance on parental mental health issues in the post-pandemic era and the emerging wave of online education.

Methods

Study design

This cross-sectional study surveyed the parents of young children. In the context of the COVID-19 pandemic and the prevalence of online classes, parents' mental health variables, including depression levels, parental stress, general psychological status, and coping styles, were measured using an anonymous online survey, and their children's ADHD symptoms were measured through parent ratings. Ethical approval for this study was obtained from the Ethics Committee of Kangning Hospital, Ningbo, Zhejiang Province, China (No. NBKNYY-2021-LC-1). A random sample of six primary schools in Ningbo, Zhejiang Province and Yuhuan County, Zhejiang Province were selected for data collection from November 2021 to January 2022. The purpose and content of the survey were explained to each respondent, and a digital informed consent form was provided for the study. All the respondents completed the questionnaire anonymously.

During this period, China adopted strict measures to control the spread of the COVID-19³⁶. Especially in Zhejiang Province, including Ningbo City and Yuhuan County, the government and education departments quickly adapted to the changing situation, ensuring the continuity of education while prioritizing public health. Therefore, many schools in China still used online learning modes due to the ongoing impact of the COVID-19 pandemic. In primary schools in Ningbo City and Yuhuan County, Zhejiang Province, these regions benefited from relatively developed digital infrastructure. Schools were equipped with the necessary technology, allowing students to access the internet and use digital devices, although there were still differences. Platforms such as DingTalk, WeChat, and specialized educational applications were widely used for teaching and maintaining communication between teachers, students, and parents^{37,38}. Concurrently, teachers received training on effectively using online teaching tools and methods. Additionally, a support system was established to assist parents and students in coping with the new educational model.

Participants

The questionnaires were completed anonymously in online class groups, and the participants were selected from different regions. The inclusion criteria were: (i) parents of children studying in Ningbo or Yuhuan County, Zhejiang Province, China, before the COVID-19 outbreak and currently, including primary school students and junior high school students; (ii) a child age of 6–13 years. Only parents participated in this survey; children did not directly participate.

Our study's sample size was determined based on established principles in international questionnaire design. These guidelines suggest that the sample size should be approximately 5 to 20 times the number of items in the questionnaire to ensure adequate data representation and reliability^{39,40}. Anticipating the possibility of non-responses or invalid questionnaires, which typically account for about 10% of the total surveys distributed⁴¹, we increased our target sample size by 10%. Therefore, the final sample size was set at 5.5 times the number of questionnaire items, ensuring that even with the anticipated rate of non-response or invalidity, we would still have a sufficiently large sample to maintain the robustness of our study's findings. Given that our study comprised 153 items, the minimum sample size was calculated at 842 (153 items \times 5.5).

In the end, 1500 questionnaires were distributed, and 1454 questionnaires were returned, yielding a response rate of 96.93%. Among these questionnaires, 138 had more than 30% missing data and logical errors and were thus recorded as invalid. There were 1,316 valid questionnaires, resulting in an effective completion rate of 90.51%.

Survey content

The general questionnaire comprised two main sections. The first part of the survey concerned sociodemographic information such as child grade, parent gender, parent education, online class approval or not, online class pressure, children's ADHD type, and parents' perceived source of their emotional impact (i.e., whether they believed their emotional impact was due to the pandemic or their child's online classes). The specific question was: "If you feel that your emotions are affected, do you think it is due to the pandemic, your child's online learning, or both?" Children's ADHD type was rated by the parent version of the SNAP-IV rating scale⁴². The categories were as follows: attention deficit dominant (≥ 6 items on the Attention Deficit Subscale 2 or 3 only), hyperactivity/impulsivity dominant (≥ 6 items on the Hyperactivity/Impulsivity Subscale 2 or 3 only), and ADHD-C (≥ 6 items on both the Attention Deficit and Hyperactivity/Impulsivity Subscale 2 or 3).

The second part concerned the mental health rating variables, including depression level, parental stress, general psychological state, and coping styles, measured by the Patient Health Questionnaire Depression Scale (PHQ-9) (0–27), the Parental Stress Scale (PSS), the General Mental Health Questionnaire (GHQ-12) (0–12), and the Brief Coping Style Scale (SCSQ). These scales have exhibited good reliability and validity in previous studies^{43–46}. These scales are classified as follows: PHQ-9: normal (0–4), mild (5–9), moderate to severe (10–14), and severe (20–27); PSS: normal (< 86), critical high (86–90), high (91–98), and very high (> 98); GHQ-12: high risk (98); GHQ-12 high (86–3), and low risk (0–1); SCSQ: positive coping (coping tendency > 0), negative coping (coping tendency < 0), where coping tendency = positive coping standard score (Z score) – negative coping standard score (Z score), and the standard score is Z-transformed using the mean and standard deviation of positive coping style and negative coping style.

To ensure the reliability and consistency of the questionnaire results, psychiatrists explained the purpose of the survey and administered it to participants. A pre-test was conducted before the main survey to explore

the questionnaire's psychometric properties, such as reliability and validity. The pre-test involved a small group of participants similar to the main study's target population. After completing the pre-test questionnaire, the researchers collected the responses, entered the data, and performed an initial analysis to identify any issues with the questionnaire items. This process helped refine the questionnaire and ensure the quality of the answers in the main survey.

Data analysis methods

After logic checking and proofreading, we used R-4.2.1 (an open-source programming language) and Rstudio for Windows (an open-source IDE) to process and analyze the data. We first conducted a descriptive analysis of the social demographic characteristics of the participants (Table 1) and a descriptive analysis of the continuous variables (PSS, PHQ-9, GHQ-12, and SCSQ) (Table 2).

The Shapiro–Wilk test⁴⁷ was used to test the normality of each variable. In addition, Spearman's rank correlation analysis⁴⁸ was used to investigate the correlations between the variables (Table 3). Spearman's rank correlation analysis was adopted because it is applicable to data with non-normal distribution and can effectively evaluate the monotonic relationship between two variables. Its results are more reliable than the chi-squared test, especially when the data are skewed. Ultimately, this study conducted a univariate intergroup analysis on each variable based on whether the parents agreed to online classes and the parents' coping styles (Table 4). The purpose was to explore the differences in parental mental health and related factors among different groups and determine possible influencing factors.

Variables (categorical)	Overall	%
Total	1316	100
Child grade		
1–3	645	49
4–6	264	20.1
7–9	407	30.9
Parent gender		
Female	855	65.0
Male	461	35.0
Parent age		
< 30	21	1.6
> 45	142	10.8
30–37	655	49.8
38–45	498	37.8
Parent education		
Primary school	78	5.9
Middle school	391	29.7
High school	333	25.3
College	497	37.8
Graduate school	17	1.3
Online class approval		
Approve	398	30.2
Disapprove	918	69.8
Online class pressure		
Very high	224	17.0
High	449	34.1
Moderate	558	42.4
No pressure	85	6.5
Emotional source		
Pandemic impact	251	19.1
Online learning	235	17.9
Both	830	63.1
Children's ADHD type		
Normal	1242	94.4
Combined type	19	1.4
Hyperactive impulsiv type	15	1.1
Inattentive type	40	3.0

Table 1. The sociodemographic characteristics of participants.

Variables (scale score)	Mean	SD	Skewness	Kurtosis	Normality (Shapiro-Wilk)
PSS	104.261	20.921	0.038	3.701	<0.001***
PHQ-9	10.751	3.331	2.801	13.680	<0.001***
GHQ-12	2.886	1.956	2.123	8.8808	<0.001***
SCSQ	0.003	1.025	0.219	3.032	<0.001***

Table 2. The distribution characteristics of scale score variables. *** $p < 0.001$.

	CG	PG	PA	PE	OLA	OLP	ES	PSS	PHQ	GHQ	ADHD	SCSQ
CG												
PG	0.01											
PA	0.5***	-0.12***										
PE	-0.45***	-0.01	-0.32***									
OLA	-0.02	-0.01	-0.01	-0.01								
OLP	-0.04	0.07*	0.04	0.15***	-0.33***							
ES	-0.08**	0.09***	-0.05	0	0.05	-0.13***						
PSS	0.02	-0.08**	0.04	-0.17***	0.15***	-0.37***	0.1***					
PHQ	0.12***	-0.04	0.08**	-0.07**	0.13***	-0.21***	0.17***	0.38***				
GHQ	0.14***	-0.05	0.09***	-0.14***	0.16***	-0.27***	0.15***	0.36***	0.54***			
ADHD	-0.08**	-0.1***	-0.01	0.03	0.11***	-0.16***	0.07*	0.18***	0.15***	0.11***		
SCSQ	-0.01	0.05	-0.03	0.05	-0.06*	0.07**	0	-0.33***	-0.21***	-0.19***	-0.07*	

Table 3. Spearman rank correlation among variables. CG—Child Grade; PG—Parent Gender; PA—Parent Age; PE—Parent Education; OLA—Online Class Approval; OLP—Online Class Pressure; ES—Emotional Source; PSS—Perceived Stress Scale; PHQ—Patient Health Questionnaire; GHQ—General Health Questionnaire; ADHD—Attention Deficit Hyperactivity Disorder. SCSQ—Simplified Coping Style Questionnaire. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In the multiple regression analysis, we examined the impact of various independent variables on the psychological health of parents (i.e., PSS, PHQ, and GHQ) under different coping styles and attitudes toward online courses. Specifically, we studied the effects of different coping styles (negative or positive) on parental mental health and related factors (Table 5). Additionally, we explored how different attitudes toward online courses (disapproving vs. approving) influenced parental mental health and related factors (Table 6). The purpose of the multiple regression analysis was to reveal the impact of each variable on the parents' mental health and related factors and provide a basis for interventive measures.

The main objectives of this study were to analyze the differences in parental mental health and its associated factors across coping styles and attitudes toward online classes, as well as to explore how factors such as children with ADHD symptoms, parental attitudes toward online classes, and parental coping styles affect parental mental health. We hope to provide strong references and recommendations for improving parental mental health through these analyses.

It is particularly noteworthy that this work considered p -values of < 0.05 statistically significant.

Results

Sociodemographic characteristics

The survey, which included 1316 participants, revealed that only a minority of parents supported online classes during the pandemic. The majority adopted positive coping methods during stressful situations. Table 1 presents detailed demographic information about the parents and their children, including grade levels, gender distribution, age ranges, and educational attainment. Additionally, Table 1 outlines the parents' perceptions of online classes, their levels of stress, sources of emotional stress, and the types of ADHD diagnosed in their children.

The distribution and correlations among variables

Table 2 presents the distribution characteristics of scores on the PSS, PHQ-9, GHQ-12, and SCSQ scales, indicating that the scores did not conform to a normal distribution regarding skewness, kurtosis, and extreme value distribution ratios.

Table 3 details the correlations between sociodemographic characteristics and mental health variables, highlighting several significant associations. Key findings include: (1) Parental stress correlated significantly with the child's grade and parent's gender, educational level, approval of online classes, stress due to online classes, and sources of emotional stress; (2) PHQ-9 scores showed significant associations with the child's grade and parental age, education, approval of online classes, online class stress, and sources of emotional stress; (3) GHQ-12 scores were significantly linked to the child's grade and parental age, education, online class recognition, online class

	OLC Disapprove	OLC Approve	p-Value	t\χ ²	Negative coping	Positive coping	p-Value	t\χ ²
Total	918	398			688	628		
Child grade (%)								
1–3	445 (48.5)	200 (50.3)	0.829	0.374	337 (49.0)	308 (49.0)	1	0.001
4–6	187 (20.4)	77 (19.3)			138 (20.1)	126 (20.1)		
7–9	286 (31.2)	121 (30.4)			213 (31.0)	194 (30.9)		
Parent gender = Female (%)	598 (65.1)	257 (64.6)	0.892	0.018	432 (62.8)	423 (67.4)	0.094	2.810
Parent age (%)								
< 30	16 (1.7)	5 (1.3)	0.799	1.007	9 (1.3)	12 (1.9)	0.085	6.619
> 45	101 (11.0)	41 (10.3)			88 (12.8)	54 (8.6)		
30–37	450 (49.0)	205 (51.5)			334 (48.5)	321 (51.1)		
38–45	351 (38.2)	147 (36.9)			257 (37.4)	241 (38.4)		
Parent education (%)								
Primary School	45 (4.9)	33 (8.3)	0.105	7.666	44 (6.4)	34 (5.4)	0.14	6.928
Middle School	285 (31.0)	106 (26.6)			213 (31.0)	178 (28.3)		
High School	230 (25.1)	103 (25.9)			185 (26.9)	148 (23.6)		
College	345 (37.6)	152 (38.2)			237 (34.4)	260 (41.4)		
Graduate School	13 (1.4)	4 (1.0)			9 (1.3)	8 (1.3)		
Online class pressure (%)								
Very High	100 (10.9)	124 (31.2)	< 0.001***	144.56	121 (17.6)	103 (16.4)	0.345	3.316
High	279 (30.4)	170 (42.7)			244 (35.5)	205 (32.6)		
Moderate	459 (50.0)	99 (24.9)			285 (41.4)	273 (43.5)		
No Pressure	80 (8.7)	5 (1.3)			38 (5.5)	47 (7.5)		
Emotional source (%)								
Pandemic Impact	198 (21.6)	53 (13.3)	0.001***	14.77	140 (20.3)	111 (17.7)	0.235	2.893
Online Learning	149 (16.2)	86 (21.6)			113 (16.4)	122 (19.4)		
Both	571 (62.2)	259 (65.1)			435 (63.2)	395 (62.9)		
ADHD type (%)								
Combined Type	8 (0.9)	11 (2.8)	0.001***	17.255	17 (2.5)	2 (0.3)	0.007**	12.061
Hyperactive Impulsive Type	7 (0.8)	8 (2.0)			10 (1.5)	5 (0.8)		
Normal	882 (96.1)	360 (90.5)			640 (93.0)	602 (95.9)		
Inattentive Type	21 (2.3)	19 (4.8)			21 (3.1)	19 (3.0)		
PSS (mean (SD))	102.27 (20.73)	108.85 (20.65)	< 0.001***	– 5.298	109.37 (20.65)	98.66 (19.77)	< 0.001 ***	9.589
PHQ-9 (mean (SD))	10.45 (2.94)	11.45 (4.02)	< 0.001***	– 5.077	11.33 (3.94)	10.11 (2.35)	< 0.001 ***	6.763
GHQ-12 (mean (SD))	2.66 (1.69)	3.41 (2.38)	< 0.001***	– 6.558	3.17 (2.16)	2.57 (1.64)	< 0.001 ***	5.607

Table 4. Single-factor analysis of participant survey data. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

stress, and emotional sources; (4) SCSQ scores correlated with parental gender, approval of online classes, and stress from online classes; (5) ADHD was significantly associated with the child's achievements and parental gender, recognition of online classes, stress from online classes, and emotional sources.

These correlations provided the basis for the subsequent analysis and are comprehensively detailed in Table 3.

The severity of measurements and associated factors

Table 4 shows the results of single-factor analyses of survey data, highlighting significant differences based on parental approval of online classes and the type of coping strategy adopted. The key findings are: (1) Parental approval of online classes: Significant differences were observed between parents who disapproved and those who approved of online classes in terms of online class pressure, emotional sources, and scores on the PSS, PHQ-9, and GHQ-12 scales ($p < 0.001$ for all); (2) Coping strategies: Parents adopting positive coping strategies (SCSQ > 0) showed significant differences in PSS, PHQ-9, and GHQ-12 scores compared to those using negative coping strategies (SCSQ < 0), with $p < 0.001$ for all comparisons. No significant differences were found in terms of sociodemographic characteristics or other factors. These analyses underscore the impact of online class approval and coping strategies on parental stress and mental health, as detailed in Table 4.

The study used multiple regression to analyze parental coping styles, attitudes toward online courses, and their impact on mental health, including the PSS, PHQ-9, and GHQ-12 dimensions, as detailed in Tables 5 and 6. The findings are summarized below.

The results from Table 5 are as follows: For negative coping, PSS scores were significantly associated with parental gender, online classroom stress, and ADHD type. Female parents and parents experiencing lower stress levels in online classrooms had lower PSS scores. Parents of children without ADHD symptoms also had lower

Variables	PSS				PHQ-9				GHQ-12			
	Negative coping		Positive coping		Negative coping		Positive coping		Negative coping		Positive coping	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
(Intercept)	147.91	0.000***	147.31	0.000***	27.01	0.000***	34.86	0.000***	18.20	0.000***	25.07	0.000***
Child grade												
1–3												
4–6	0.91	0.693	–2.80	0.200	0.43	0.659	–0.17	0.775	–0.01	0.995	–0.28	0.596
7–9	0.15	0.945	–1.55	0.487	3.79	0.000***	2.56	0.000***	2.83	0.000***	2.38	0.000***
Parent gender												
Male												
Female	–4.29	0.013*	–0.35	0.833	–1.35	0.065	0.22	0.639	–0.92	0.114	0.08	0.837
Parent age												
< 30												
>45	–12.16	0.110	5.40	0.390	–2.45	0.447	–0.99	0.573	–2.11	0.410	–1.18	0.430
30–37	–6.99	0.331	1.56	0.783	–3.16	0.301	0.28	0.862	–2.92	0.229	–0.06	0.964
38–45	–7.21	0.324	4.86	0.400	–1.86	0.548	0.94	0.558	–1.76	0.476	0.78	0.570
Parent education												
Primary School												
Middle School	0.33	0.927	–2.75	0.452	3.36	0.026*	0.39	0.704	2.93	0.015*	–0.36	0.676
High School	1.18	0.746	–10.84	0.004**	4.39	0.005**	–0.32	0.760	3.62	0.003**	–0.93	0.293
College	–6.81	0.068	–10.54	0.005**	3.48	0.028*	–0.24	0.819	2.79	0.027*	–0.73	0.407
Graduate School	3.71	0.636	–5.90	0.439	4.56	0.172	–1.52	0.475	3.67	0.166	–2.52	0.164
Online class approval												
Disapprove												
Approve	2.04	0.268	2.27	0.215	1.62	0.039*	1.71	0.001***	1.45	0.020*	1.64	0.000***
Online class pressure												
Very High												
High	–7.59	0.002**	–8.37	0.000***	–1.59	0.123	–1.47	0.027*	–1.41	0.085	–1.21	0.032*
Moderate	–16.85	0.000***	–15.75	0.000***	–3.97	0.000**	–2.08	0.002**	–3.65	0.000***	–2.10	0.000***
No Pressure	–31.38	0.000***	–27.46	0.000***	–5.72	0.001***	–2.91	0.005**	–5.10	0.000***	–3.33	0.000***
Emotional source												
Pandemic Impact												
Online Learning	–0.23	0.931	–1.57	0.551	–0.56	0.628	–1.05	0.151	–0.72	0.436	–1.12	0.074
Emotional source Both	3.13	0.143	1.43	0.509	1.94	0.033*	1.04	0.087	1.42	0.049*	0.63	0.219
ADHD type												
Combined Type												
Hyperactive Impulsive Type	–7.57	0.375	–9.72	0.548	1.56	0.667	–6.66	0.141	2.16	0.454	–4.64	0.227
Normal	–3.77	0.476	–20.19	0.140	–1.92	0.394	–12.82	0.001***	–0.47	0.794	–9.29	0.004**
Inattentive Type	12.72	0.069	–7.15	0.619	3.66	0.216	–10.07	0.012*	3.20	0.175	–7.14	0.037*
Multiple R ² /F-statistic/p-value	0.1772\7.57***		0.2032\8.162***		0.1237\4.965***		0.1460\5.473***		0.1346\5.468***		0.1921\7.610***	

Table 5. Comparison of Multivariate Regression Results of Parental Mental Health and Its Related Factors Under Different Coping Styles. The variables in the last row, 'Multiple R²', 'F-statistic', and 'p-value', indicate the key metrics of the regression model, providing information on the proportion of variance explained, the overall significance of the model, and the statistical significance of the results, respectively. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

PSS scores compared to those with the combined ADHD type; PHQ-9 scores were significantly associated with the child's grade and parental education, online classroom agreement, and emotional source. Higher PHQ-9 scores were noted among parents of older children, parents with higher education, those agreeing to online classes, and those influenced by both COVID-19 and online learning. GHQ-12 scores were significantly associated with the child's grade and parental education, online classroom agreement, and emotional source. Higher GHQ-12 scores were found among parents of older children, parents with higher education, those agreeing to

Variables	PSS			PHQ-9			GHQ-12					
	Disapprove OLC		Approve OLC	Disapprove OLC		Approve OLC	Disapprove OLC		Approve OLC			
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value		
(Intercept)	133.98	0.000***	129.65	0.000***	20.26	0.000***	32.39	0.000***	12.63	0.000***	23.91	0.000***
Child grade												
1-3												
4-6	-1.89	0.314	0.76	0.792	0.45	0.471	-0.57	0.651	0.27	0.594	-1.13	0.273
7-9	-1.22	0.509	-0.07	0.981	2.89	0.000***	3.68	0.003**	2.35	0.000***	2.84	0.005**
Parent gender												
Male												
Female	-2.03	0.147	-3.01	0.180	-0.12	0.793	-1.31	0.180	-0.12	0.747	-0.89	0.265
Parent age												
<30												
>45	-7.80	0.153	15.11	0.128	-0.22	0.903	-3.01	0.487	0.09	0.951	-4.16	0.238
30-37	-7.43	0.142	18.01	0.051	-0.63	0.706	-2.69	0.503	-0.46	0.735	-3.62	0.268
38-45	-6.56	0.204	18.89	0.043*	-0.22	0.899	-0.62	0.880	0.05	0.974	-1.68	0.612
Parent education												
Primary School												
Middle School	1.46	0.646	-4.78	0.255	1.15	0.276	3.90	0.034	0.88	0.299	2.68	0.073
High School	-2.61	0.421	-6.04	0.162	2.25	0.037*	1.73	0.360	1.71	0.048*	0.80	0.601
College	-6.37	0.052	-10.35	0.020*	2.07	0.058	1.05	0.586	1.52	0.083	0.24	0.877
Graduate School	2.36	0.707	-10.51	0.334	4.13	0.049*	-5.70	0.230	2.94	0.081	-5.75	0.138
Online class pressure												
Very High												
High	-3.96	0.090	-9.47	0.000***	-0.22	0.773	-2.18	0.040*	-0.26	0.677	-1.88	0.030*
Moderate	-11.96	0.000***	-21.63	0.000***	-2.23	0.003**	-3.57	0.004**	-2.19	0.000***	-3.53	0.000***
No Pressure	-25.00	0.000***	-25.39	0.006**	-3.26	0.002**	-7.43	0.066	-3.46	0.000***	-6.87	0.037*
Emotional source												
Pandemic Impact												
Online Learning	-1.89	0.387	1.28	0.727	-0.62	0.395	-0.10	0.952	-0.76	0.191	-0.13	0.921
Emotional source Both	2.59	0.127	2.52	0.422	1.42	0.013*	1.68	0.221	0.83	0.068	1.59	0.154
ADHD type												
Combined Type												
Hyperactive Impulsive Type	2.77	0.788	-6.87	0.474	10.97	0.001***	-5.38	0.200	9.51	0.001***	-3.06	0.371
Normal	1.04	0.883	-8.86	0.167	1.66	0.483	-5.93	0.034*	2.35	0.216	-3.42	0.133
Inattentive Type	17.58	0.033*	3.23	0.682	5.50	0.045*	-1.69	0.623	5.18	0.019	-0.77	0.782
SCSQ	-6.54	0.000***	-7.84	0.000***	-1.59	0.000***	-2.60	0.000***	-1.29	0.000***	-2.08	0.000***
Multiple R ² /F-statistic	0.27307469***		0.236714660***		0.216815506***		0.144818001***		0.201915033***		0.162919196***	
p-value												

Table 6. Comparison of Multivariate Regression Results of Parental Mental Health and Its Related Factors Under Different Attitudes Toward Online Classes. The variables in the last row, 'Multiple R²', 'F-statistic', and 'p-value', indicate the key metrics of the regression model, providing information on the proportion of variance explained, the overall significance of the model, and the statistical significance of the results, respectively. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

online classes, and those influenced by both COVID-19 and online learning. For positive coping, PSS scores were associated with parental education and online classroom stress. Parents with higher education and those with lower online classroom stress had lower PSS scores. PHQ-9 scores correlated with the child's grade, online classroom stress, and ADHD type. Parents of older children, those with lower online classroom stress, and those with children without ADHD symptoms had lower PHQ-9 scores. GHQ-12 scores correlated with online classroom stress and ADHD type. Parents with lower online classroom stress and those with children without ADHD symptoms had lower GHQ-12 scores.

Table 6 further compares the results of multiple regressions under different attitudes toward coping with online classes.

Concerning PSS scores, among parents disapproving of online classes, those aged 38–45 had higher scores, while college-educated parents had lower scores. Among approving parents, moderate online classroom stress and higher SCSQ scores were associated with lower PSS scores. Concerning PHQ-9 scores, among disapproving parents, those with a postgraduate degree had higher scores. Among approving parents, higher scores were noted for parents of older children and those with high online classroom stress, while higher SCSQ scores were linked to lower PHQ-9 scores. Regarding GHQ-12 scores, among disapproving parents, those with children having attention deficit ADHD had higher scores. Among approving parents, higher scores were observed for parents of older children and those with high online classroom stress, while higher SCSQ scores correlated with lower GHQ-12 scores.

These analyses illustrate the complex relationships between parental coping styles, attitudes toward online classes, and various mental health dimensions. Detailed results are presented in Tables 5 and 6.

Discussion

Since the gradual outbreak of COVID-19 in late 2019, the virus has exhibited an unimaginably high level of infectiousness⁴⁹. As of 3 April 2020, there had been at least 52,869 deaths and 10,066 confirmed cases of COVID-19 infection; by 18 May 2020, the number of confirmed cases had increased to 4,679,511, with 315,005 deaths. Frighteningly, these numbers rapidly increased, with many people having secondary infections⁵⁰. The rapid spread of COVID-19 worldwide posed a serious challenge to the entire human population on many fronts: health, economic, environmental, and social. The impact on the education sector has been particularly significant: to avoid the mass gathering of young students, most schools were forced to opt out of the face-to-face mode of delivery and instead turn to online learning. Although online learning is not new, this massive, long-term paradigm shift presented significant challenges for children and parents alike⁵¹. Sun et al. indicated that students subjected to the online delivery mode for a long time since the spread of COVID-19 were more likely to fall behind in their grades and be affected by various aspects of psychological stress⁵². The impact on pupils can easily be passed on to parents to varying degrees, becoming a psychological burden and challenge. However, much of the current research is based on the perspective of educators and children, often ignoring the attitudes and mental health factors of the parents.

In a multifactorial study of the impact of parental attitudes and coping styles on mental health in the context of online delivery during the COVID-19 pandemic, parents' agreement with online delivery was only 30.24%, and 52.28% adopted positive coping styles in times of stress. We found that the significant factors for parental mental health (measured as PSS, PHQ-9, and GHQ-12 quantitative values) were parental gender, the child's grade, perceived stress about online classes, whether the child has ADHD, positive or negative coping styles, and subjective attitudes toward supporting online classes. This study separately examined the influence of individual child characteristics and subjective parental attitudes and behavioral patterns on their mental health.

Individual child characteristics

The analysis of children's ADHD subtypes revealed that the regression coefficients for the quantified values of parental psychological problems were significantly lower for parents of children without ADHD compared to parents of children with mixed ADHD symptoms (Tables 5 and 6). However, it is noteworthy that the regression coefficient was positive when parents disagreed with online classes, which might be due to subjective negative parental attitudes masking the impact of the child with ADHD on the parent's mental health. ADHD, whose main symptoms are inattention, hyperactivity, and impulsivity, is one of the most common psychiatric disorders, with a prevalence of 4–6% in children and adolescents^{53,54} and 5.6% in this study (Table 1). Interestingly, the mental health impact of children with ADHD on their parents was similar across time. One study on the parents of children with ADHD found that such parents were at greater risk of developing psychopathology⁵⁵. This type of phenomenon showed a more pronounced trend during the COVID-19 pandemic in the context of a long-term home isolation policy and multiple social pressures. The unfamiliarity with electronic devices, concerns about performance in online classes, and the hyperactivity and inattention of children with ADHD symptoms continue to impact parents' psychological defenses, ultimately leading to a range of mental health problems. Research has shown that the majority of children with ADHD (40–60%) exhibit both oppositional defiant disorder (ODD) and/or conduct disorder⁵⁶. This oppositional psychology or behavior toward elders was often amplified in the online mode of instruction during the COVID-19 pandemic due to the long hours spent together.

In addition, this study found significant effects on parents' mental health when their children were in the middle and upper grades. Interestingly, the higher grades did not increase parental stress but instead increased parental depression and reduced the general psychological state of GHQ-12 scores of the parents (Tables 5 and 6). In a study on the consistency of parental anxiety with children, it was reported that in 76% of the parents in the sample who suffered from depressive psychological problems, the children tended also to have some mental health problems. This was often an indirect link, and this effect was not found in younger children⁵⁷. In the context of the COVID-19 pandemic, the online mode of delivery led to varying degrees of adaptation and

concerns about academic performance, often creating a state of stress and anxiety among students, particularly in the context of the long-term home isolation policy. Often, as students progress through the grades, the burden of schoolwork and the pressure to progress to higher education intensifies this phenomenon. Parents who either respond positively or negatively to online classes, with some threat to employment, salary packages, etc., all expressed concerns about online classes, especially when their children were at some critical point in their senior years. Several studies have found that the correlation between psychological problems such as parental and child depression increases with the child's age^{58,59}. Even parents who have some reservations about the online mode of instruction for their younger children show some tolerance and emotion compared to their attitudes toward the online instruction of their middle and upper school children, contributing to a relatively relaxed state of mind and psychological situation. Although parents who experience depression and other psychological states in the face of heavy academic pressure on their children in the upper grades are often less able to cope with the difficulties of the upper grades and the gradual expression of their children's sense of autonomy, the parental pressure in this situation is not significant^{60,61}.

Parents' willingness to respond in a subjective way

This study focused on the impact of long-term online teaching of children on parental mental health during the COVID-19 pandemic, specifically regarding parents adopting two distinctly different behavioral approaches, negative or positive. The univariate group comparisons in Table 4 show that parental adoption of positive coping resulted in significantly lower mean scores on the PSS, PHQ-9, and GHQ-12 (109.37–98.66, 11.33–10.11, and 3.17–2.57). During the global spread of the virus, the fear of getting sick inspired more negative emotions dominated by stress, anxiety, and other psychological disorders⁶². A study in Iran showed that 34.8%, 32.2%, and 29% of the adult population in the Yazd region had negative psychological symptoms such as stress, anxiety, and depression, respectively, during the COVID-19 pandemic⁶³. Health concerns, accompanied by economic stagnation and various aspects of the child's schooling, have resulted in strong negative psychological feedback from parents during the COVID-19 period, especially in a negative way. With this negative behavioral approach, accompanied by a distrust of electronic devices and online delivery modes, parents often voice doubts about the effectiveness of their children's lessons. However, the parental pressure and anxiety brought about by this pandemic can easily demotivate students and discourage them from learning⁶⁴. Children who lose interest in learning will eventually regress in the long-term online mode, and this vicious circle will further feed parents' frustration with the online mode. As shown in Table 5, in the multiple regression results for parental mental health and its correlates under different coping styles, we found an interesting phenomenon: among parents who maintained a negative coping style, men tended to show high levels of parental stress significance (i.e., a decrease of 2.03 for women compared to men), and the parents with a positive coping style did not show significant gender-differentiated behavior. In addition, the lower the level of stress parents experienced from online classes was, the lower the regression coefficients were for the quantitative values of parental psychological problems. Furthermore, parents who maintained a positive coping style had higher regression coefficients compared to those with negative coping styles (Table 5). Active parental involvement in family education is crucial to the child's development⁶⁵, and it is relatively easier to maintain a healthy psychological level in such a benign parenting relationship. Pratama et al. showed through a study of parental feedback in the face of home-based online classes during the pandemic⁶⁶ that positive parental coping in the face of a long-term online delivery model is an effective safeguard for advancing children's learning progress, which forms, to some degree, a virtuous cycle.

It is also worth noting, as shown in Table 4, that subjective parental disapproval of online instruction resulted in significantly lower mean scores on the PSS, PHQ-9, and GHQ-12 (108.85–102.27, 11.45–10.45, and 3.41–2.66). Thus, in addition to the differential impact of how parents respond to long-term online classes, the subjective willingness or unwillingness to support online classes showed a similarly significant impact. Although some have argued that parental involvement in the child's learning experience during COVID-19 is unprecedented, the fact is that parental behavioral interference and even subjective attitudes have a profound impact on the child's learning and have done so for decades^{67–69}. Plowman et al. showed that children's online learning requires more subjective support and assistance from parents than formal supervision⁷⁰. Our analysis revealed that when parents reported subjective agreement with online classes, their perception of low stress associated with these classes was more negatively correlated with levels of psychological well-being than when they disagreed with online classes (as rated by the PSS, PHQ, and GHQ) (Table 6). A 2019 study found that parents' attitudes toward their children's online learning affected the quality of their children's learning⁷¹ and that children's learning often feeds back to some extent on the parents' mental health state. The above phenomenon may be because the expectations of these parents are more aligned with reality. They may have a negative perception of online delivery, so their expectations of its effectiveness are lower. As a result, they may feel less stress and disappointment when reality meets their expectations. Conversely, parents who identify with online delivery may have higher expectations and feel more stress and disappointment when reality does not meet those expectations.

Finally, parents should show a more tolerant and supportive attitude to the online teaching model for students during COVID-19, even in the face of the many stressors that arise at home. With the rapid development of technology and the spread of new electronic devices in modern society, this online mode of delivery will not just be a significant feature of the COVID-19 period but will gradually become more common in the future. A range of theories derived from motivation research, such as self-determination theory⁷², expectancy-value theory⁷³, and achievement goal theory⁷⁴, suggest that active involvement in children's learning processes, with the intervention of a facilitator and the provision of some external motivators, can effectively address the psychological factors that influence learner motivation, engagement, and learning. Therefore, it is only by being more optimistic and accepting of new things and by motivating their children to varying degrees that parents can guide their children to adjust to their mental health.

Strengths & limitations

We analyzed the differences in parental mental health and its correlates across coping styles and attitudes toward online classes and explored how factors such as children with ADHD symptoms, parental attitudes toward online classes, and parental coping styles all affect parental mental health. The results suggest that, at a time when online delivery is becoming socially acceptable, attention must be paid to the risk of mental illness it poses to parents. In addition, policies and interventions need to be developed to increase parental acceptance of online delivery. It is hoped that this study can provide effective guidance on parental mental health issues in the post-pandemic era and the emerging wave of online education. In addition, the results of this study are based on a relatively large sample drawn from a randomized whole group and may partially reflect the mental health characteristics of parents of school-aged children aged 6–13 years in China between pandemics and, to some extent, represent the sociological characteristics of parents suffering from mental health problems under the pressure of online delivery. The present results may serve as a reference for countries with similar cultural backgrounds.

However, our study has several limitations. First, this study is a cross-sectional survey limited in its ability to provide longitudinal judgments of the development of parental mental disorder characteristics, and longitudinal prospective observations may be considered in the future. In addition, the parenting stress, general mental health, and depression scales included in the survey contain a wide range of behaviors of varying clinical relevance, and some atypical behaviors may not be captured by these scales. Furthermore, there is a significant imbalance in group sizes between children with normal ADHD and those with other types of ADHD, which might affect the generalizability and precision of our findings. This imbalance highlights the need for larger sample sizes for each ADHD subtype in future research. Despite combining all other types of ADHD into one group for analysis, the imbalance remains, and this issue should be addressed in future studies.

Conclusion

Few reports are available on parents' mental health factors against the background of long-term online teaching during COVID-19. Therefore, in this study, we conducted a multifactorial survey on the impact of parents' attitudes and coping styles on their mental health in this context. The results showed that during the COVID-19 pandemic in China, facing the long-term online teaching mode, parents of senior children and children with ADHD showed a higher risk of depression and other psychological disorders due to excessive worry and anxiety. In addition, there was a close relationship between parents' subjective attitudes and behavioral patterns and their mental health status: parents who adopted a positive coping style were relatively less susceptible to the negative impact of both the pandemic and online teaching, so they gradually adapted to their children's online teaching mode and provided guidance to varying degrees. Subjectively, parents who did not agree with online teaching had a better mental health status compared to parents who agreed with online courses. The findings of this work can provide practical guidance on parental mental health issues in the post-pandemic era and the emerging wave of online education, with a focus on the stresses that online classes induce in parents, improving parental acceptance of online classes and their mental health, and providing further psychological relief measures and health programs for different groups of students and parents.

Data availability

The data that support the findings of this study are available on request from the corresponding author, [Liu], upon reasonable request.

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References

- Zhu, N. *et al.* A novel corona-virus from patients with pneumonia in China, 2019. *N. Engl. J. Med.* **382**(8), 727–733. <https://doi.org/10.1056/NEJMoa2001017> (2020).
- Drosten, C. *et al.* Identification of a novel coronavirus in patients with severe acute respir-atory syndrome. *N. Engl. J. Med.* **348**(20), 1967–1976. <https://doi.org/10.1056/NEJMoa030747> (2003).
- Ksiazek, T. G. *et al.* A novel coronavirus associated with severe acute respiratory syndrome. *N. Engl. J. Med.* **348**(20), 1953–1966. <https://doi.org/10.1056/NEJMoa030781> (2003).
- Zaki, A. M. *et al.* Isola-tion of a novel coronavirus from a man with pneumonia in Saudi Arabia. *N. Engl. J. Med.* **367**(19), 1814–1820. <https://doi.org/10.1056/NEJMoa1211721> (2012).
- World Health Organization, 2020. Coronavirus disease 2019 (COVID-19). Situation Report-55. World Health Organ-ization. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports> [Accessed on Mar. 16, 2020].
- Fry, K. E-learning markets and providers: Some issues and prospects. *Educ. Train.* **43**(4/5), 233–239. <https://doi.org/10.1108/EUM000000005484> (2001).
- Hrastinski, S. Asynchronous and synchronous e-learning. *Educ. Quart.* **31**(4), 51–55 (2008).
- Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies.
- Tallent-Runnels, M. K. *et al.* Teaching courses online: A review of the research. *Rev. Educ. Res.* **76**(1), 93–135. <https://doi.org/10.3102/00346543076001093> (2006).
- Joshi, O. *et al.* Benefits and challenges of online instruction in agriculture and natural resource education. *Interact. Learn. Environ.* <https://doi.org/10.1080/10494820.2020.1725896> (2020).
- Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause Review*, (March 27, 2020).
- Bozkurt, A. & Sharma, R. C. Emergency remote teaching in a time of global crisis due to Corona Virus pandemic. *Asian J. Dist. Educ.* **15**(1), i–iv (2020).
- Branch, R. M. & Dousay, T. A. *Survey of instructional development models* 5th edn. (Association for Educational Communications and Technology, UK, 2015).
- Vlachopoulos, D. COVID-19: Threat or opportunity for online education. *High. Learn. Res. Commun.* **10**(1), 2 (2020).

15. Tomasik, M. J., Helbling, L. A. & Moser, U. Educational gains of in-person vs. distance learning in primary and secondary schools: A natural experiment during the COVID-19 pandemic school closures in Switzerland. *Int. J. Psychol.* **56**, 566–576. <https://doi.org/10.1002/ijop.12728> (2020).
16. Blume, F., Schmidt, A., Kramer, A. C., Schmiedek, F. & Neubauer, A. B. Homeschooling during the SARS-CoV-2 pandemic: the role of students' trait self-regulation and task attributes of daily learning tasks for students' daily self-regulation. *Z. Erzieh.* **24**, 367–391. <https://doi.org/10.1007/s11618-021-01011-w> (2021).
17. Manca, S. & Delfino, M. Adapting educational practices in emergency remote education: continuity and change from a student perspective. *Br. J. Educ. Technol.* **2021**, 1–20. <https://doi.org/10.1111/bjet.13098> (2021).
18. Bonal, X. & González, S. The impact of lockdown on the learning gap: Family and school divisions in times of crisis. *Int. Rev. Educ.* **66**, 635–655. <https://doi.org/10.1007/s11159-020-09860-z> (2020).
19. Savage, M. J. *et al.* Mental health and movement behaviour during the COVID-19 pandemic in UK university students: Pro-spective cohort study. *Ment. Health Phys. Act.* **19**, 100357 (2020).
20. Khan, A. H. *et al.* The impact of COVID-19 pandemic on mentalhealth & wellbeing among home-quarantined Bangladeshi students: A cross-sectional pilot study. *J. Affect. Disord.* **277**, 121–128 (2020).
21. Jiang, R. Knowledge, attitudes and mental health of university students during the COVID-19 pandemic in China. *Child. Youth Serv. Rev.* **119**, 105494 (2020).
22. Essadek, A. & Rabeyron, T. Mental health of French students during the Covid-19 pandemic. *J. Affect. Disord.* **277**, 392–393 (2020).
23. Kaparounaki, C. K. *et al.* University students' mental health amidst the COVID-19 quarantine in Greece. *Psychiatry Res.* **290**, 113111 (2020).
24. Copeland, W. E. *et al.* Impact of COVID on collegestudent mental health and wellness. *J. Am. Acad. Child Adolesc. Psychiatry* **60**(1), 134–141 (2020).
25. Soykan, E. Views of students', teachers' and parents on the tablet computer usage in education. *Cypriot J. Educ. Sci.* **10**(3), 228–228 (2015).
26. Wößmann, L. *et al.* Bildung in der Coronakrise: Wie haben die Schulkinder Die Zeit der Schulschließungen Verbracht, und welche Bildungsmaßnahmen Befürworten die Deutschen?. *Ifo Schnelldienst* **73**, 25–39 (2020).
27. Pelikan, E. R. *et al.* Learning during COVID-19: the role of self-regulated learning, motivation, and procrastination for perceived competence. *Z. Erzieh.* **24**, 393–418. <https://doi.org/10.1007/s11618-021-01002-x> (2021).
28. Hale, L., Troxel, W. & Buysse, D. J. Sleep health: An opportunity for public health to address health equity. *Annu. Rev. Public Health* **41**(1), 81–99 (2020).
29. Jiao, W. Y. *et al.* Behavioral and emotional disorders in children during the COVID-19 epidemic. *J. Pediatr.* **221**, 264–266. <https://doi.org/10.1016/j.jpeds.2020.03.013> (2020).
30. Hai, T., Swansburg, R., MacMaster, F. P. & Lemay, J. F. Impact of COVID-19 on educational services in Canadian children with attention-deficit/hyperactivity disorder. *Front. Educ.* **6**, 614181. <https://doi.org/10.3389/educ.2021.614181> (2021).
31. Tassarollo, V. *et al.* Distance learning in children with and without ADHD: A case-control study during the COVID-19 pandemic. *J. Affect. Disord.* **26**, 902–914. <https://doi.org/10.1177/10870547211027640> (2022).
32. Hasler-Waters, L., Menchaca, M. P. & Borup, J. Parental Involvement in K-12 Online and Blended Learning. In *Handbook of Research on K-12 Online and Blended Learning* (eds Kennedy, K. & Ferdig, R. E.) 303–324 (ETC Press, 2014).
33. Killgore, W. D. S., Cloonan, S. A., Taylor, E. C. & Dailey, N. S. Loneliness: A signature mental health concern in the era of COVID-19. *Psychiatry Res.* **290**, 113117 (2020).
34. Xin, M. *et al.* Negative cognitive and psychological correlates of mandatory quarantine during the initial COVID-19 outbreak in China. *Am. Psychol.* **75**(5), 607–617 (2020).
35. Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T. & Stephenson, D. Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspect. Psychol. Sci.* **10**(2), 227–237 (2015).
36. Tian, H. *et al.* An investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China. *Science* **368**(6491), 638–642 (2020).
37. Xie Z, Yang J. Autonomous learning of elementary students at home during the COVID-19 epidemic: A case study of the second elementary school in Daxie, Ningbo, Zhejiang Province, China. Ningbo, Zhejiang Province, China (March 15, 2020), 2020.
38. Zhang, W. *et al.* Suspending classes without stopping learning: China's education emergency management policy in the COVID-19 outbreak. *J. Risk Financ. Manag.* **13**(3), 55 (2020).
39. Hair, J. F. *et al.* *Multivariate Data Analysis* 7th edn. (Pearson Prentice Hall, 2010).
40. Nunnally, J. C. & Bernstein, I. H. The assessment of reliability. *Psychometric Theory* **3**, 248–292 (1994).
41. Bartlett, J. E., Kotrlik, J. W. & Higgins, C. C. Organizational research: Determining appropriate sample size in survey research. *Inf. Technol. Learn. Perform. J.* **19**, 43–50 (2001).
42. Gau, S. S. F. *et al.* Psychometric properties of the Chinese version of the Swanson, Nolan, and Pelham, version IV scale–parent form. *Int. J. Methods Psychiatric Res.* **17**(1), 35–44. <https://doi.org/10.1002/mpr.237> (2008).
43. Qin, Z. *et al.* Research and analysis on the optimal cutoff value of Chinese version PHQ-9 for screening depression in different populations. *J. Clin. Digest. Dis.* **31**(5), 4 (2019).
44. Wang, W. *et al.* The optimal cutoff values and screening characteristics of different scoring methods in 12 general health questionnaires. *Chin. J. Psychiatry* **45**(6), 5 (2012).
45. Qin, X. *et al.* A study on parental stress and related factors in mothers of children with autism. *Chin. J. Ment. Health* **23**(009), 629–633 (2009).
46. Wang, C. *et al.* A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain Behav. Immun.* **87**, 40–48. <https://doi.org/10.1016/j.bbi.2020.04.028> (2020).
47. González-Estrada, E. & Cosmes, W. Shapiro–Wilk test for skew normal distributions based on data transformations. *J. Statist. Comput. Simul.* **89**(17), 3258–3272 (2019).
48. Lyerly, S. B. The average Spearman rank correlation coefficient. *Psychometrika* **17**(4), 421–428 (1952).
49. Kumari, T. & Shukla, V. Covid-19: Towards confronting an unprecedented pandemic. *Int. J. Biol. Innov.* **2**(1), 1–10. <https://doi.org/10.46505/IJBI.2020.2101> (2020).
50. Chakraborty, I. & Maity, P. COVID-19 outbreak: Migration, effects on society, global environment and prevention. *Sci. Total Environ.* **728**, 138882 (2020).
51. Adedoyin, O. B. & Soykan, E. Covid-19 pandemic and online learning: the challenges and opportunities. *Interact. Learn. Environ.* <https://doi.org/10.1080/10494820.2020.1813180> (2020).
52. Sun, S. (2020, August 22). Rural primary education in Cambodia during the pandemic: Challenges and solutions. <https://cefcambodia.com/2020/08/22/rural-primary-education-in-cambodia-during-the-pandemic-challenges-and-solutions/>.
53. Brown, R. T. *et al.* Prevalence and assessment of attention-deficit/hyperactivity disorder in primary settings. *Pediatrics.* **107**, 43 (2001).
54. Scahill, L. & Schwab-Stone, M. Epidemiology of ADHD in school-age children. *Child. Adolesc. Psychiatr. Clin. N. Am.* **9**, 541–555 (2000).
55. Agha, S. S., Zammit, S., Thapar, A. & Langley, K. Maternal psychopathology and offspring clinical outcome: A four-year follow-up of boys with ADHD. *Eur. Child Adolesc. Psychiatry* <https://doi.org/10.1007/s00787-016-0873-y> (2016).

56. August, G. J., Realmunto, G. M., MacDonald, A. W. III., Nugent, S. M. & Crosby, R. Prevalence of ADHD and comorbid disorders among elementary school children screened for disruptive behavior. *J. Abnormal Child. Psychol.* **24**, 571–595 (1996).
57. Frick, P. J., Silverthorn, P. & Evans, C. Assessment of child-hood anxiety using structured interviews: Patterns of agreement among informants and association with maternal anxiety. *Psychol. Assess.* **6**, 372–379 (1994).
58. Edelbrock, C., Costello, A. J., Dulcan, M. K., Conover, N. C. & Kala, R. Parent–child agreement on child psychiatry symptoms via structured interview. *J. Child. Psychol. Psychiatry* **27**, 181–190 (1986).
59. Verhulst, F. C., Althaus, M. & Berden, F. M. G. The child assessment schedule: Parent child agreement and validity measures. *J. Child. Psychol. Psychiatry* **28**, 455–466 (1987).
60. Nye, C., Turner, H. & Schwartz, J. Approaches to parent involvement for improving the academic performance of elementary school age children. *Campbell Syst. Rev.* **2**(1), 1–49. <https://doi.org/10.4073/csr.2006.4> (2006).
61. Eccles, J. S. & Harold, R. D. Parent-school involvement during the early adolescent years. *Teach. Coll. Record* **94**(3), 568–658 (1993).
62. Liu, Y., Gayle, A. A., Wilder-Smith, A. & Rocklöv, J. The reproductive number of COVID-19 is higher compared to SARS coronavirus. *J. Travel Med.* **76**, 71–76 (2020).
63. Mirzaei, M., Yasini Ardekani, S. M., Mirzaei, M. & Dehghani, A. Prevalence of depression, anxiety and stress among adult population: Results of Yazd health study. *Iran. J. Psychiatry* **14**(2), 137–146 (2019).
64. Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K. & Goetz, T. Achievement emotions and academic performance: Longitudinal models of reciprocal effects. *Child Dev.* **88**(5), 1653–1670 (2017).
65. Kellaghan, T., Sloane, K., Alvarez, B. & Bloom, B. S. *The Home Environment and School Learning: Promoting Parental Involvement in the Education of Children* (Jossey-Bass, 1993).
66. Pratama, A. R. & Firmansyah, F. M. Disengaged, positive, or negative: Parents' attitudes toward learning from home amid COVID-19 pandemic. *J. Child. Fam. Stud.* **30**(7), 1803–1812 (2021).
67. Fishel, M. & Ramirez, L. Evidence-based parent involvement interventions with school-aged children. *School Psychol. Quart.* **20**(4), 371. <https://doi.org/10.1521/scpq.2005.20.4.371> (2005).
68. Gross, D. *et al.* What is parent engagement in early learning? Depends who you ask. *J. Child. Fam. Stud.* **29**(3), 747–760. <https://doi.org/10.1007/s10826-019-01680-6> (2020).
69. Topor, D. R., Keane, S. P., Shelton, T. L. & Calkins, S. D. Parent involvement and student academic performance: a multiple mediation analysis. *J. Prevent. Intervent. Commun.* **38**(3), 183–197. <https://doi.org/10.1080/10852352.2010.486297> (2010).
70. Plowman, L. & Stephen, C. Children, play, and computers in pre-school education. *Br. J. Educ. Technol.* **36**(2), 145–157. <https://doi.org/10.1111/j.1467-8535.2005.00449.x> (2005).
71. Erdogan, N. I., Johnson, J. E., Dong, P. I. & Qiu, Z. Do parents prefer digital play? Examination of parental preferences and beliefs in four nations. *Early Childh. Educ. J.* **47**, 131–142. <https://doi.org/10.1007/s10643-018-0901-2> (2019).
72. Ryan, R. M. & Deci, E. L. Intrinsic and extrinsic motivation from a self-determination theory perspective: definitions, theory, practices, and future directions. *Contemp. Educ. Psychol.* <https://doi.org/10.1016/j.cedpsych.2020.101860> (2020).
73. Wigfield, A. & Eccles, J. S. Expectancy–value theory of achievement motivation. *Contemp. Educ. Psychol.* **25**(1), 68–81 (2000).
74. Senko, C., Hulleman, C. S. & Harackiewicz, J. M. Achievement goal theory at the crossroads: Old controversies, current challenges, and new directions. *Educ. Psychol.* **46**(1), 26–47 (2011).

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Author contributions

F.C., L.C., and H.X. conceived and designed the experiments. C.W. and R.D. performed the experiments and collected data. D.C. and J.L. analyzed the data. H.Y. and L.L. contributed to the writing of the manuscript and provided critical revisions that addressed important intellectual content. All authors discussed the results and implications and commented on the manuscript at all stages. *H.Y. and L.L. also served as corresponding authors, overseeing the project coordination and ensuring the integrity of the work from inception to published article. F.C. and L.C. contributed equally to this work due to L.C. significant contributions in completing the revisions.

Competing interests

The authors declare no competing interests.

Ethical approval

This survey was conducted following the principles of the Declaration of Helsinki. The following information was supplied relating to ethical approvals (i.e., approving body and any reference numbers): The Ningbo Kangning Hospital granted Ethical approval to carry out the study within its facilities (Ethical Application Ref. No.: NBKNYY-2021-LC-1, 2021.3.15–2024.3.14).

Additional information

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