

Parental Involvement, Academic Self-Efficacy, and Depression on Academic Performance Among Chinese Students During COVID-19 Pandemic

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Objective: This study was conducted to identify the factors (especially parental involvement, academic self-efficacy, and depression) associated with academic performance among Chinese K-12 students during the COVID-19 pandemic.

Methods: This cross-sectional study used data from the 2020 China Family Panel Studies (CFPS). The CFPS was conducted from July to December 2020 during the COVID-19 pandemic. A multistage probability sample proportional to size was used for the survey. The final sample consisted of 1747 K-12 students. This study used the 14-item Chinese Parental Involvement and Support Scale, the Responsibility Scale, and the 8-item Center for Epidemiologic Studies Depression Scale to measure parental involvement, academic self-efficacy, and depression, respectively. An ordered probit regression and structural equation models were employed to analyze the factors associated with academic performance. A multiple imputation technique was applied to compute missing values in selected variables.

Results: We found that parental involvement and academic self-efficacy were positively associated with good academic performance. In contrast, depression was negatively associated with good academic performance. Moreover, academic stress, male, rural residency, middle school, family size, high income, online gaming daily, reading, and intelligence quotient were statistically significant predictors on academic performance.

Conclusion: The empirical findings suggested that parental involvement and academic self-efficacy were positively and significantly associated with good academic performance. However, depression was negatively and significantly associated with good academic performance. These results showed that policymakers and practitioners can help improve academic success and address educational inequalities among K-12 students by implementing a series of reforms.

Keywords: parental involvement, academic self-efficacy, depression, academic performance, K-12, COVID-19 pandemic, China

Introduction

The World Health Organization (WHO), on 11 March 2020, declared the Coronavirus Disease 2019 (COVID-19) outbreak as a global pandemic.¹ The COVID-19 pandemic has changed the world, and everything has been impacted. Educational activities have been significantly altered in the way of knowledge transmission and the learning environment. Over 120 countries have closed schools impacting about a billion students globally.² School shutdown could lead to falling test scores on average.³

The outbreak of COVID-19 spreading across China began in January 2020. In response to the COVID-19 pandemic, the Chinese government launched an emergency policy, “Classes Suspend but Learning Continues”, which required online teaching and learning activities while all schools were closed.⁴ Approximately 220 million children and adolescents have taken online courses in China.⁵ Fortunately, K-12 schools nationwide are equipped with essential facilities for online teaching, and most students can access digital learning technology.^{6,7} Since then, a national-scale online teaching and learning experiment has been conducted in China.

Unlike college students who may have experienced online learning before the COVID-19 pandemic, the sudden transition to online learning is problematic during the COVID-19 for Chinese K-12 students who often lack prior experience.^{8,9} Not only China but also Japan, the Philippines, and Thailand initially struggled to implement online learning for K-12 students.^{10,11} There is a negative effect of school closures on academic performance among younger students during the COVID-19 pandemic.¹² Many educators and parents worry about K-12 students returning to school with lower academic performance when emergencies end. Another worry is that the gap between good- and poor academic performance students becomes more extensive compared to pre-pandemic.¹³ Therefore, understanding the factors that affected K-12 students' academic performance during the COVID-19 pandemic will help to design policy reforms to improve academic success and address educational inequalities during emergencies and regular academic environments.

Several studies defined parental involvement as activities that parents engage in at home and school and positive attitudes parents have towards their child's education.¹⁴ Before the COVID-19 pandemic, the findings are mixed on how parental involvement affects academic performance: positive, negative, and no relationship has been reported. A large number of studies show that parental involvement in their child's education is positively associated with good academic performance,^{15–18} while some studies report that parental involvement is associated with poor academic performance or has less pronounced effects on academic performance.^{19–22} During the COVID-19 pandemic, parents have an enormous responsibility for their child's education, while teachers and schools cannot supervise the students directly. Parental involvement is seen as essential to a child's academic success during the COVID-19 pandemic. However, limited research has been conducted on how parental involvement affects academic performance during emergencies.²³

Academic self-efficacy may be defined as an individual's belief in his or her ability to accomplish a specific task in an academic situation.^{24,25} High academic self-efficacy leads an individual to believe in his or her ability to perform a specific task successfully.²⁶ Therefore, academic self-efficacy is consistently found to be positively associated with good academic performance.^{27,28} During the COVID-19 pandemic, K-12 students in online learning require greater self-direction and self-regulation to succeed academically.²⁹ Little is known about the relationship between academic self-efficacy and academic performance in online learning environments during emergencies.

The shutdown of various activities during the COVID-19 period may have adversely affected the mental health of K-12 students and increased levels of stress, anxiety, and depression.^{30,31} An inverse relationship between mental health and academic performance is well-known in the literature.³² However, there has been limited research on how mental health affects academic performance in emergency situations.

In summary, K-12 students have been significantly affected, including knowledge acquisition process, personalized learning, and learning communication mode. Understanding the factors that affect academic performance during the COVID-19 pandemic will help design effective interventions for improving students' academic performance. However, evidence on how parental involvement, academic self-efficacy, and mental health affect academic performance in an online setting and during emergency situations is limited. Therefore, the current study was conducted to identify the factors (especially parental involvement, academic self-efficacy, and depression) associated with academic performance among Chinese K-12 students during the COVID-19 pandemic.

Methods

Conceptual Model

The COVID-19 pandemic has forced students to adapt to unfamiliar online learning. No in-person interactions and no peer pressure and effects. This study's conceptual model differs from the previous conceptual models.^{33,34} Parental involvement, academic self-efficacy, and depression play essential roles in having good academic performance during the COVID-19 pandemic. [Figure 1](#) presents the conceptual model of this study.

Research Design

The research design used in the study is a cross-sectional study.

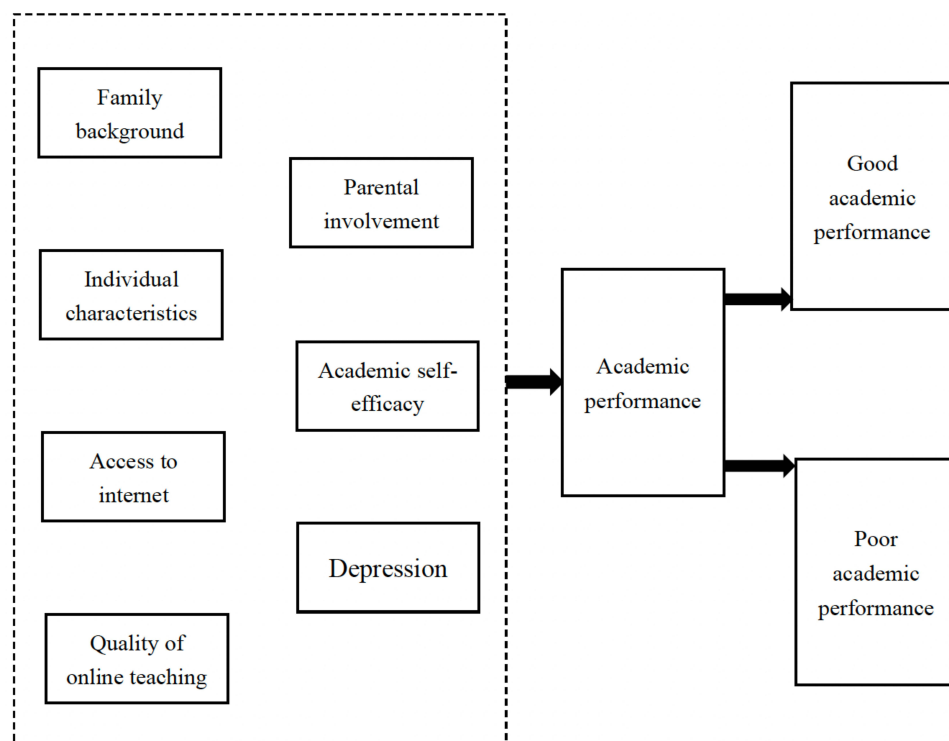


Figure 1 Conceptual framework to identify relevant factors affecting academic performance of students during the COVID-19 pandemic.

Data Sources

We used the 2020 China Family Panel Studies (CFPS), initiated by the Institute of Social Science Survey (ISSS), Peking University, for this analysis. The data of this study were obtained from the CFPS in July 2023. The CFPS is a general-purpose, nationally representative biennial survey. The survey covers twenty-five provinces and their administrative equivalents, representing approximately 95% of the total population in mainland China. Five provinces or administrative equivalents (Liaoning, Shanghai, Henan, Guangdong, and Gansu) were selected to oversample populations, and the remaining twenty provinces or administrative equivalents were grouped (see Figure 2). A multistage probability sample proportional to size was used for the survey. More details on the sampling and data collection process are available in Xie and Hu.³⁵

The CFPS primarily conducts face-to-face interviews. When the CFPS fails to complete face-to-face interviews, telephone or web-based interviews are used as a substitute. The CFPS respondents are reinterviewed every two years, with the first wave in 2010 and five follow-ups happening during 2012, 2014, 2016, 2018, and 2020. The 2020 CFPS was conducted during the COVID-19 pandemic, and 25,082 individuals successfully completed full-length questionnaires. In the current study, we selected K-12 students as target samples. From the full sample, only the individuals who were enrolled in elementary, middle, or high school at the time of the interview were selected for this study. We excluded the K-12 students did not finish parental involvement, academic self-efficacy, and depression tests. The final sample consisted of 1747 K-12 students.

Measures

Academic Performance

The study aims to explain the academic performance of Chinese students during the COVID-19 pandemic. For empirical analysis, a variable reflecting academic performance was used. Academic performance was defined as an ordered categorical variable with values ranging from 0 to 4, 0 indicating academic performance falls within the bottom 24% of students, 1 indicating the placement of students between the top 51%-75%. 2 when academic performance is between

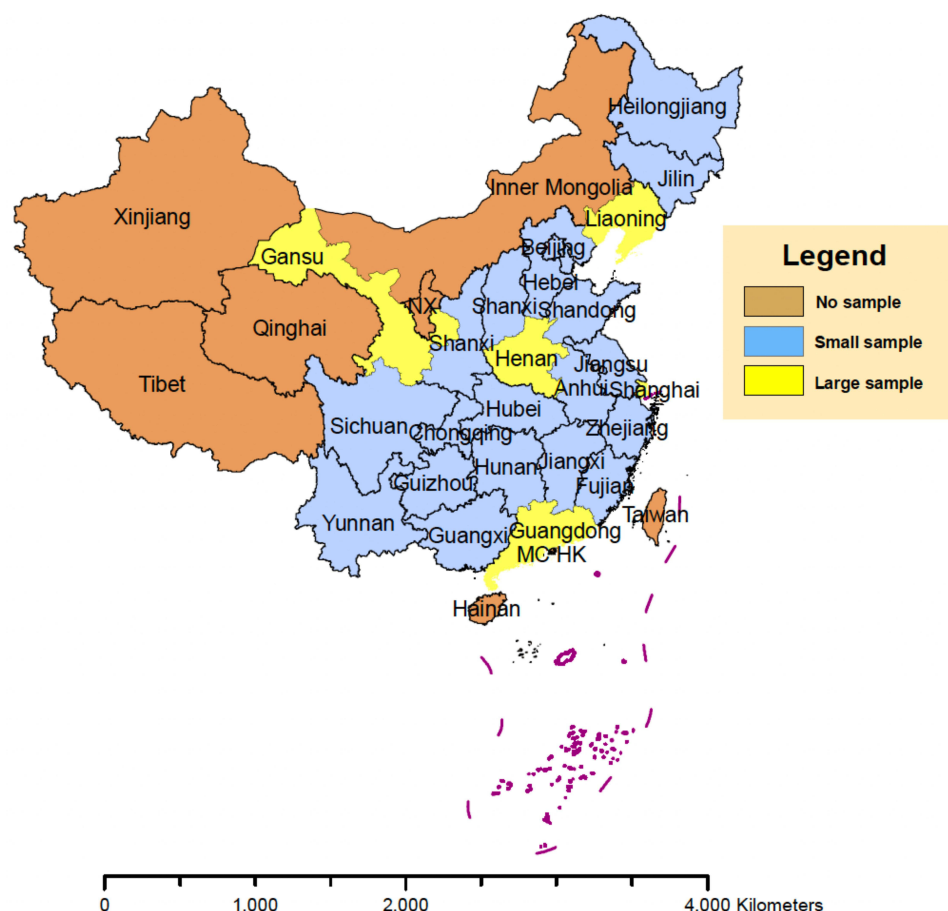


Figure 2 The representativeness of the samples.

the top 26%-50%, 3 between the top 11%-25%, and 4 when performance is at the top 10% level. The CFPS used the following question to obtain the information: “What was your rank in your class in the most recent examination?”. Response option for the question: Top 10%, 11–25%, 26–50%, 51–75%, Bottom 24%, or School does not release the rank. We treated the “School does not release the rank” option equaling missing.

Parental Involvement

The CFPS utilized the 14-item Chinese Parental Involvement and Support Scale (CPISS-14) to understand the children receiving supports and incentives from their parents.³⁶ In the current study, nine items (eg, the parents encourage the child to work hard, ask the child about things at school, and check the child’s homework) were used to assess how actively the parents involve themselves directly in their children’s education. Each item is rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Parental involvement was calculated as the arithmetic mean of answers to the nine items. Moreover, a latent variable, “parental involvement”, was measured with nine observed items using confirmatory factor analysis (CFA).

Academic Self-Efficacy

The present study used the Responsibility Scale to measure children’s academic self-efficacy,³⁷ which includes six items (eg, the child studies very hard, respects the rules and the order, and likes to keep all his/her school things in great order). Items are rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The Responsibility Scale to measure academic self-efficacy has been suggested by several previous studies.^{38,39} Academic self-efficacy was

calculated as the arithmetic mean of answers to the seven items. Moreover, a latent variable, “academic self-efficacy”, was measured with six observed items using CFA.

Depression

This study used the 8-item Center for Epidemiologic Studies Depression Scale (CESD-8) to assess depressive symptoms, developed from the full-length version of the CESD-20. In the CFPS, each respondent was asked, “How often have you felt or behaved this way during the last week?”. The survey consists of six negative items (eg, I am in a low spirit, I cannot sleep well, and I feel sad.) and two positive items (I feel happy and I have a happy life.), which can be rated on a 4-point Likert scale from 0 (never: less than one day) to 3 (most of the times: 5–7 days). The negative items were assigned the value of 0, 1, 2, and 3, while the positive items were assigned 3, 2, 1, and 0. In total, the range of the CESD-8 total score is 0 to 24, with high scores indicating higher levels of depressive symptoms. The CESD-8 has been proven to be easy to administer, valid, and reliable and showed good construct and criterion validity concerning the CESD-20.^{40,41} Moreover, a latent variable, “depression”, was measured with eight observed items using CFA.

Covariates

Consistent with the conceptual framework, the study included several individual and household variables. The following covariates were selected to explain academic performance: male, age, rural residency, household income, family size, academic stress, online gaming, online learning, study time, reading, intelligence quotient, educational stage, and public school. The definitions of the variables are provided in Table 1.

Table 1 Definitions of Variables Used in the Empirical Analysis of Academic Performance

Variable	Description	Mean (Std)	%
Academic performance (AP)		3.60 (1.21)	
Level 1	Bottom 24%		7.12
Level 2	Between 51%-75%		11.68
Level 3	Between 26%-50%		24.02
Level 4	Between 11%-25%		28.81
Level 5	Top 10%		28.37
Parental involvement (PI)		3.21 (0.67)	
PI1	The parents ask for reasons when the child do something wrong.	3.54 (1.10)	
PI2	The parents encourage the child to work hard.	3.74 (1.02)	
PI3	The parents enjoy communicating with their child.	3.69 (1.00)	
PI4	The parents ask the child about things at school.	3.64 (0.97)	
PI5	The parents check the child's homework.	3.19 (1.23)	
PI6	The parents help the child with his/her homework.	2.81 (1.29)	
PI7	The parents tell stories to their child.	1.81 (1.10)	
PI8	The parents play with their child	2.65 (1.18)	
PI9	The parents attend parent's meetings.	3.79 (1.18)	
Academic self-efficacy (ASE)		3.89 (0.49)	
ASE1	The child studies very hard.	3.64 (0.79)	
ASE2	During class-time, the child is concentrated on the things he/she does.	3.87 (0.75)	
ASE3	When the child finishes his/her homework, he/she checks it many times to see if he/she did it correctly.	3.66 (0.86)	
ASE4	The child respects the rules and the order.	4.28 (0.60)	
ASE5	The child likes to keep all his/her school things in great order.	4.01 (0.76)	

(Continued)

Table 1 (Continued).

Variable	Description	Mean (Std)	%
ASE6	The child plays only after he/she finished his/her homework.	3.85 (0.81)	
Depression (MH)	Center for Epidemiologic Studies Depression Scale (CESD-8), individual sum score is 0 to 24.	12.37 (3.47)	
MH1	I am in a low spirit.	1.70 (0.82)	
MH2	I find it difficult to do anything.	1.56 (0.76)	
MH3	I cannot sleep well.	1.44 (0.76)	
MH4	I feel happy.	1.84 (0.82)	
MH5	I feel lonely.	1.42 (0.73)	
MH6	I have a happy life.	1.73 (0.78)	
MH7	I feel sad.	1.53 (0.71)	
MH8	I feel that I cannot continue with my life	1.15 (0.48)	
Academic stress	The child's subjective perceptions of study stress are maximum at school		6.99
Male	The individual was male		52.83
Age	Actual age in years	12.49 (2.09)	
Rural residency	The individual was rural resident		57.57
Household income			
Low income	The child's household income is in the first quartile		25.17
Lower middle income	The child's household income is in second quartile		25.76
Upper middle income	The child's household income is in the third quartile		24.08
High income	The child's household income is in the highest quartile		25.00
Family size	Number of members with the household	5.37 (2.05)	
Online gaming			
Never	The child never played online games in the last week		37.73
Some days	The child played online games some days in the last week		44.63
Every day	The child played online games every day in the last week		17.63
Online learning			
Never	The child never participated in online courses in the last week		56.17
Some days	The child participated in online courses some days in the last week		29.29
Every day	The child participated in online courses every day in the last week		14.54
Study time	Total hours of study time in a week	12.45 (4.95)	
Reading	The child reads books in the past 12 months		84.80
Intelligence quotient	The interviewer assesses the score child's intelligence quotient based on his/her observations	5.21 (1.46)	
Public school	The school that the college students are currently attending is public school		89.59
Educational stage			
Elementary school	The child attends elementary school		61.42
Middle school	The child attends middle school		31.83
High school	The child attends high school		6.75

Multiple Imputation of Missing Values

Rubin first introduced missingness mechanisms in 1976.⁴² Three fundamental missing-data mechanisms are typically classified, which are missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR), respectively. MCAR occurs when the missingness is unrelated to that unit's observed and unobserved value. MAR means that the probability of a missing value for an item may depend on observed data but not unobserved data. MNAR implies that the probability of missingness depends on the underlying value of an item.⁴³ The current study reported that the median non-response rate was 3.12% (ranging from 0.06% to 28.16%). Little's missing completely at random test and logit models were employed for these missing data to assess if data is MCAR or MAR. The tests (data are not shown) have shown that missing data are MAR.

Multiple imputation allows researchers to increase the availability of data points, thus reducing biases when observations with missing data are deleted, which would be valid if performed under the assumption of MAR.⁴⁴

Multiple imputation has three basic steps: imputation, analysis, and pooling. In the imputation phase, we created 50 copies to reduce the sampling error due to imputations, and the missing values were replaced by imputed values using multiple imputation by chained equations (MICE). The MICE is a practical approach to impute missing data in multiple variables based on a set of univariate imputation models. We selected the conditional models based on the type of variables. The variables listed in Table 1 were used in the imputation models. We also included two auxiliary variables (self-rated health and physical activity). Each of the 50 completed datasets was analyzed using a desired statistical method in this phase. The results obtained from 50 completed datasets are combined into a single multiple-imputation result in the pooling phase. The single parameter estimate is the mean of the $n(=50)$ parameter estimates of \hat{Q} :

$$\bar{Q} = n^{-1} \sum_{i=1}^n \hat{Q}_i$$

Rubin's multiple imputation variance estimator is expressed below:

$$T = \bar{U} + \left(1 + \frac{1}{n}\right) B$$

where $\bar{U} = n^{-1} \sum_{i=1}^n U_i$ is the estimated within imputation variance. U_i is estimated variance from imputed data. $B = (n-1)^{-1} \sum_{i=1}^n (\hat{Q}_i - \bar{Q})^2$ is the between imputation variance.⁴⁵

Statistical Analysis

This study began with an ordered probit regression model to analyze the factors associated with academic performance based on imputed data, which included parental involvement, academic self-efficacy, and depression as independent variables. The ordered probit model builds a latent regression and is defined as follows:

$$y^* = x'\beta + \varepsilon$$

where x' is a vector of independent variables; β is the coefficient vector; and y^* is an unobserved latent variable linked to the observed ordinal response levels of academic performance (AP). We assume that the errors ε are normally distributed across observations and standardized at the mean of zero and variance of 1.

$$AP = \begin{cases} 0, & \text{if } y^* \leq \mu_0 \\ 1, & \text{if } \mu_0 < y^* \leq \mu_1 \\ 2, & \text{if } \mu_1 < y^* \leq \mu_2 \\ 3, & \text{if } \mu_2 < y^* \leq \mu_3 \\ 4, & \text{if } \mu_3 < y^* \end{cases}$$

where μ are the underlying thresholds that define the theoretical distribution of the levels of academic performance, subject to the constraint that $\mu_0 < \mu_1 < \mu_2 < \mu_3$. The probability would be:

$$Prob(AP = 0|x) = \Phi(\mu_0 - x'\beta)$$

$$Prob(AP = 1|x) = \Phi(\mu_1 - x'\beta) - \Phi(\mu_0 - x'\beta)$$

$$Prob(AP = 2|x) = \Phi(\mu_2 - x'\beta) - \Phi(\mu_1 - x'\beta)$$

$$Prob(AP = 3|x) = \Phi(\mu_3 - x'\beta) - \Phi(\mu_2 - x'\beta)$$

$$Prob(AP = 4|x) = 1 - \Phi(\mu_3 - x'\beta)$$

The ordered probit model was estimated using maximum likelihood estimation. The results are presented as coefficients (Coef.) and their standard errors (SEs).

Subsequently, a confirmatory factor analysis (CFA) was employed to examine the validity of parental involvement, academic self-efficacy, and depression. A total of nine items were loaded onto parental involvement (PI1-PI9), six items

onto academic self-efficacy (ASE1-ASE6), and eight items onto depression (MH1-MH8). The second analysis used in this study was structural equation modeling (SEM) to analyze the impact of parental involvement, academic self-efficacy, and depression on academic performance. The model was estimated with the maximum likelihood method with missing values. All statistical analyses were conducted employing Stata Version 17 (StataCorp, College Station, TX).

Ethical Considerations

The CFPS survey was reviewed and approved by the ISSS of Peking University, Beijing, China (IRB00001052-14010). All participants provided their written informed consent to participate in this study. Informed consent was obtained from their parents/ Legal guardians. The data were released to the researchers without access to any personal data.

Results

General Characteristics of Subjects

A descriptive summary of all variables is shown in Table 1. The sample size was 1747 respondents, with 52.83% of students being male and 57.57% reporting living in rural areas. The average age of the students was approximately 12.5 years old. In addition, 61.42%, 31.83%, and 6.75% of the students attended elementary, middle, and high school, respectively. Academic performance, parental involvement, and academic self-efficacy were measured using a 5-point Likert scale; the average scores were 3.60, 3.21, and 3.89, respectively. The mean CESD-8 score was 12.37.

Figure 3 shows the average parental involvement, academic self-efficacy, and depression score by academic performance. The average parental involvement and academic self-efficacy score show a decreasing trend from academic performance at the top 10% level to the bottom 24%. However, the average depression score increased from academic performance at the top 10% level to the bottom 24%.

Ordered Probit Regression Analysis on Academic Performance

The results of the ordered probit regression analysis are reported in Table 2. The results imply that parents highly involved in their child's education were positively associated with good academic performance (Coef.=0.130, $p<0.01$). Students with higher academic self-efficacy were more likely to have good academic performance (Coef.=0.418, $p<0.01$). Students with higher depression scores had a lower probability of having good academic performance (Coef.=−0.017, $p<0.05$).

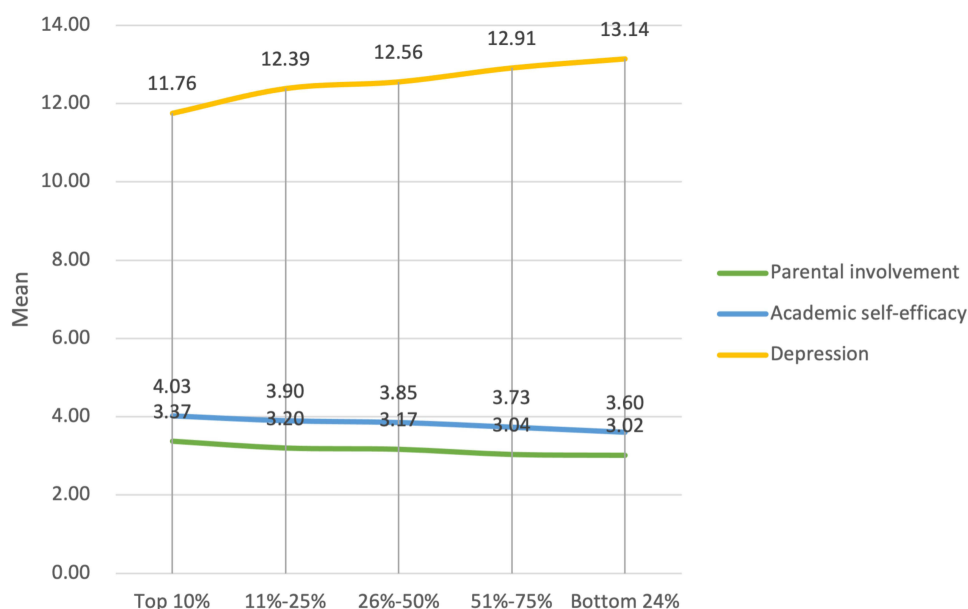


Figure 3 The average parental involvement, academic self-efficacy, and depression score by academic performance.

Table 2 Ordered Probit Regression Analysis on Academic Performance

	Coef	SE
Parental involvement	0.130***	0.049
Academic self-efficacy	0.418***	0.070
Depression	−0.017**	0.009
Academic stress	−0.325***	0.107
Male	−0.189***	0.064
Age	−0.004	0.028
Rural residency	0.100*	0.061
Household income		
Low income (Ref.)		
Lower middle income	0.002	0.080
Upper middle income	0.044	0.085
High income	0.161*	0.084
Family size	−0.025*	0.015
Online gaming		
Never (Ref.)		
Some days	−0.108	0.084
Every day	−0.239**	0.109
Online learning		
Never (Ref.)		
Some days	−0.099	0.078
Every day	−0.057	0.104
Study time	0.005	0.006
Reading	0.150*	0.084
Intelligence quotient	0.049**	0.020
Public school	0.106	0.094
Educational stage		
Elementary school (Ref.)		
Middle school	−0.218**	0.109
High school	−0.202	0.183
Observations	1747	

Note: Asterisks *** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

The probability of having good academic performance decreased with tremendous academic pressure (Coef.=−0.325, $p<0.01$). Male students were less likely to perform well academically (Coef.=−0.189, $p<0.01$). Students who lived in rural areas showed an increased probability of having good academic performance (Coef.=0.100, $p<0.1$). Students with high household incomes showed higher odds of having good academic performance than those with low household incomes (Coef.=0.161, $p<0.1$). The probability of having good academic performance decreased with higher family sizes (Coef.=−0.025, $p<0.1$). Students who played online games daily were less likely to have good academic performance than those who had never played online games (Coef.=−0.239, $p<0.05$). Students who spent time on reading had a higher probability of having good academic performance (Coef.=0.150, $p<0.1$). Students with higher intelligence quotient levels were more likely to have good academic performance (Coef.=0.049, $p<0.05$). Compared to elementary school students, middle school students had a decreased likelihood of having good academic performance (Coef.=−0.218, $p<0.05$).

Constructing the Latent Variables “Parental Involvement”, “Academic Self-Efficacy”, and “Depression”

The CFA model was used in this study as a measurement model (see Table 3). A three-factor model was evaluated: parental involvement, academic self-efficacy, and depression. Parental involvement was defined by (standardized factor

Table 3 Results of Confirmatory Factor Analysis of Parental Involvement, Academic Self-Efficacy, and Depression

Factor	Items	Standardized Factor Loading	P value	Reliability (Raykov's rho)
Parental involvement	PI1	0.473	<0.001	0.778
	PI2	0.543	<0.001	
	PI3	0.574	<0.001	
	PI4	0.526	<0.001	
	PI5	0.651	<0.001	
	PI6	0.649	<0.001	
	PI7	0.463	<0.001	
	PI8	0.568	<0.001	
	PI9	0.278	<0.001	
Academic self-efficacy	ASE1	0.599	<0.001	0.720
	ASE2	0.648	<0.001	
	ASE3	0.571	<0.001	
	ASE4	0.392	<0.001	
	ASE5	0.441	<0.001	
	ASE6	0.586	<0.001	
Depression	MH1	0.588	<0.001	0.727
	MH2	0.570	<0.001	
	MH3	0.545	<0.001	
	MH4	0.204	<0.001	
	MH5	0.646	<0.001	
	MH6	0.251	<0.001	
	MH7	0.688	<0.001	
	MH8	0.544	<0.001	
Observations	1747			

loading in parentheses) checking the child's homework (0.651), helping the child with his/her homework (0.649), communicating with their child (0.574), playing with their child (0.568), encouraging the child to work hard (0.543), asking the child about things at school (0.526), asking for reasons when the child do something wrong (0.473), telling stories to their child (0.463), and attending parent's meetings (0.278). Academic self-efficacy was defined by concentrating on things (0.648), studying very hard (0.599), playing only after he/she finished his/her homework (0.586), checking homework many times (0.571), keeping all his/her school things in great order (0.441), and respecting the rules and the order (0.392). Depression was defined by feeling sad (0.688), feeling lonely (0.646), having low spirit (0.588), having difficulty doing anything (0.570), poor sleep (0.545), cannot continue with my life (0.544), happy life (0.251), and feeling happy (0.204). The composite reliability of parental involvement, academic self-efficacy, and depression factors were above the cut-off value of 0.7 (Raykov's rho=0.778, 0.720, and 0.727).⁴⁶

Parental Involvement, Academic Self-Efficacy, and Depression Associated with Academic Performance

The SEM was used to test whether parental involvement, academic self-efficacy, and depression were significantly related to academic performance. The overall model had a statistical value of the χ^2 test ($\chi^2=1768.54$, $df=247$, $P<0.001$); CFI (0.82), RMSEA (0.059 with 95% confidence interval of 0.057–0.062) are represented, which is an accepted model has a good fit since $CFI \geq 0.8$ and $RMSEA \leq 0.08$.^{47,48} Figure 4 shows the model of parental involvement, academic self-efficacy, depression, and academic performance. Parental involvement and academic self-efficacy were positively and significantly associated with good academic performance (Coef.=0.071, $p<0.05$; Coef.=0.267, $p<0.01$). However, depression was negatively and significantly associated with good academic performance (Coef.=−0.061, $p<0.05$).

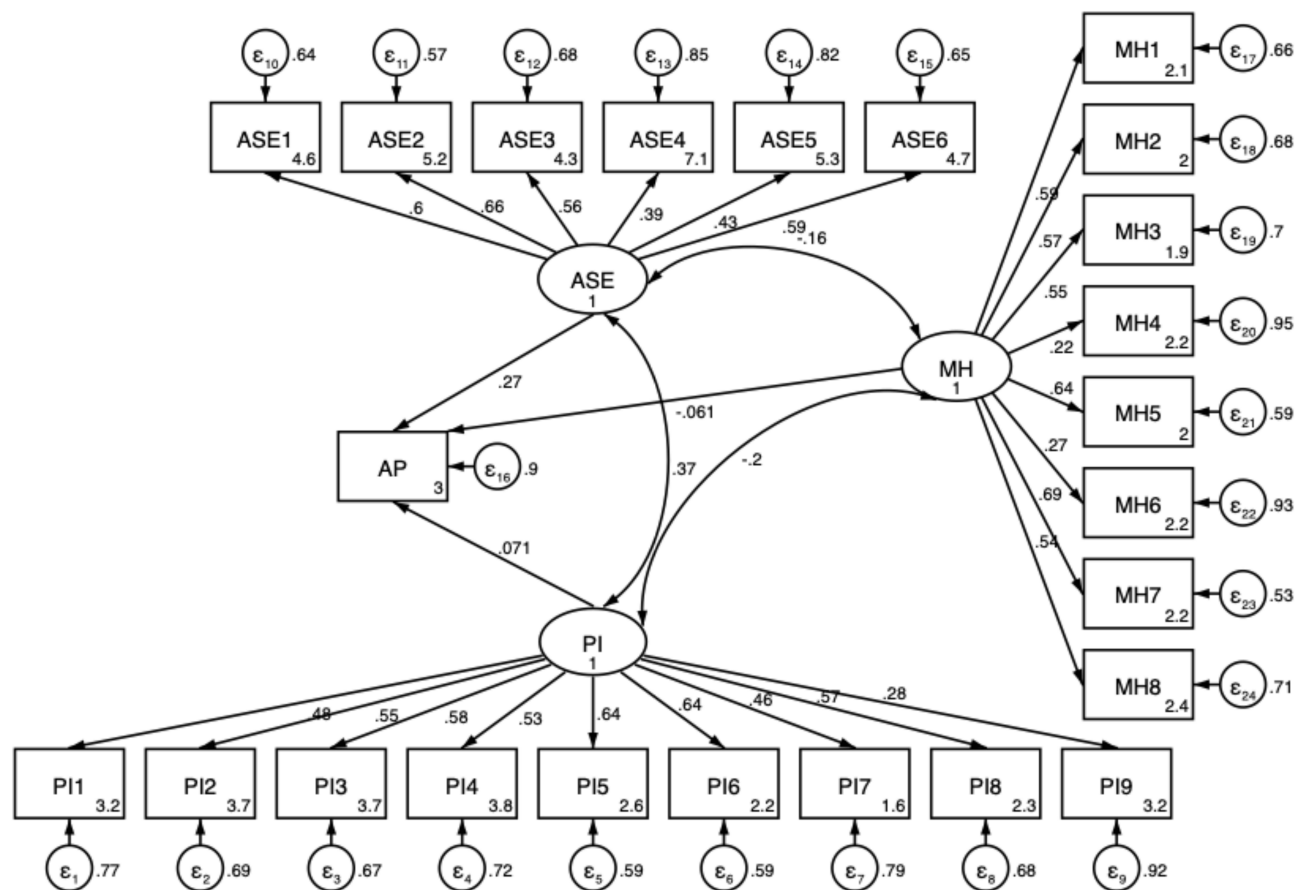


Figure 4 Results of structural equation modeling using path diagram.

Factors Associated with Academic Performance

Based on previous results from the ordered probit model, we used several grouping variables: academic stress, male, rural residency, middle school, family size, high income, online gaming daily, reading, and intelligence quotient. The SEM was estimated using maximum likelihood estimation with robust standard error correction. Table 4 and Figure 5

Table 4 Results of Structural Equation Modeling to Explain Academic Performance

Variables	Standardized Coefficient	Robust SEs	P
Parental involvement	0.084	0.034	0.013
Academic self-efficacy	0.238	0.034	<0.001
Depression	-0.064	0.032	0.041
Academic stress	-0.074	0.027	0.006
Male	-0.091	0.027	0.001
Rural residency	0.049	0.026	0.065
Middle school	-0.076	0.025	0.002
Family size	-0.047	0.028	0.092
High income	0.050	0.026	0.058
Online gaming daily	-0.059	0.034	0.081
Reading	0.054	0.027	0.050
Intelligence quotient	0.069	0.026	0.008
Observations	1747		

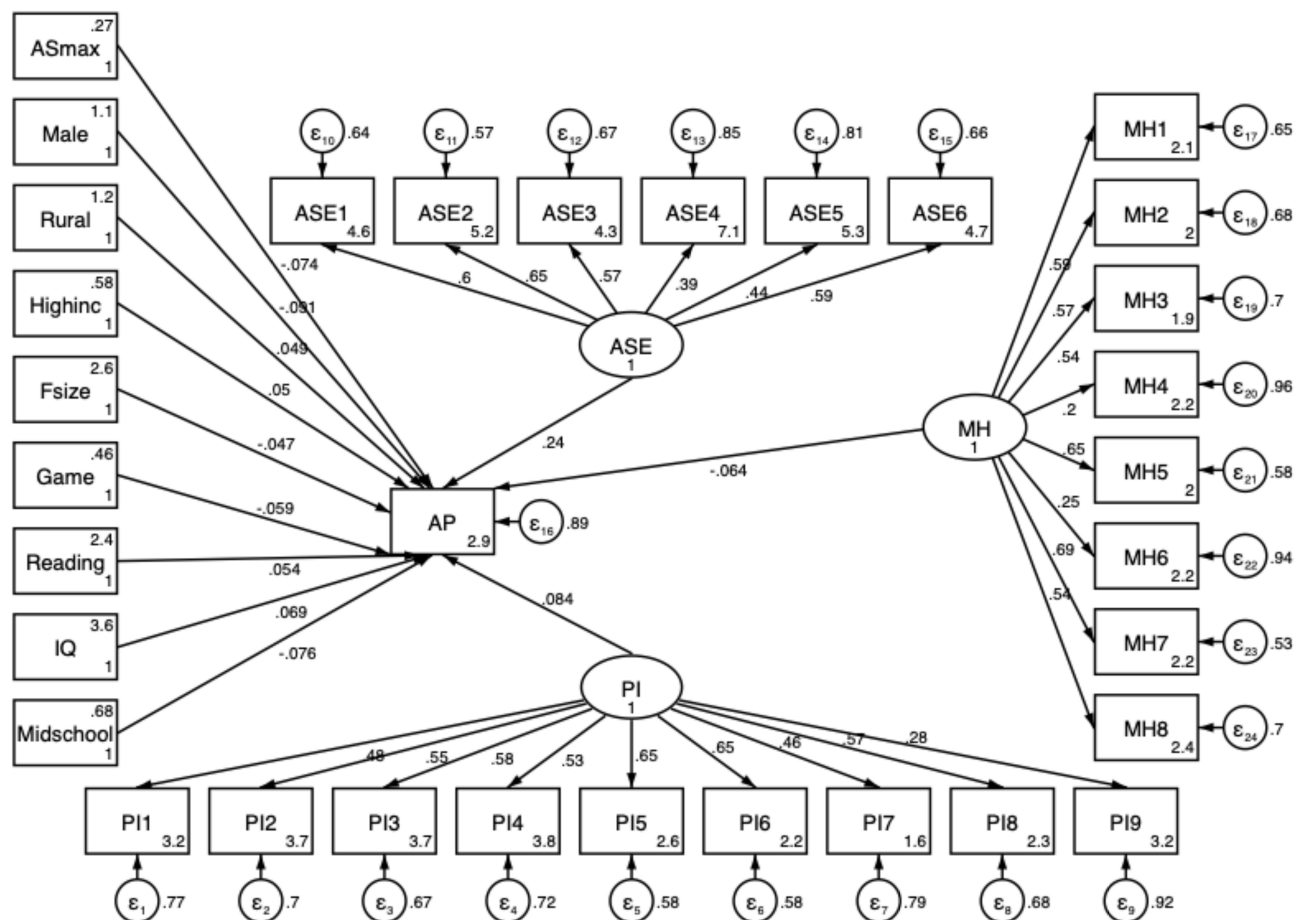


Figure 5 Results of structural equation modeling using path diagram including grouping variables.

show the results of structural equation modeling explaining academic performance. Parental involvement, academic self-efficacy, and depression were significantly associated with academic performance (Coef.=0.084, $p<0.05$; Coef.=0.238, $p<0.01$; Coef.=−0.064, $p<0.05$). Moreover, academic stress, male, rural residency, middle school, family size, high income, online gaming daily, reading, and intelligence quotient were statistically significant predictors on academic performance.

Discussion

The current study examined the factors (especially parental involvement, academic self-efficacy, and depression) associated with the academic performance of Chinese K-12 students during the COVID-19 pandemic. The results indicate that parents highly involved in their child's education were positively associated with good academic performance during the COVID-19 pandemic. During the COVID-19 pandemic, teachers expect parents to help them create a positive collaborative learning environment with no rigid boundaries between face-to-face and distance learning.⁴⁹ Parents can act as teacher's assistants, ensuring their child's online class attendance, staying on task, and troubleshooting technical problems. In addition, the early childhood education level requires higher parental involvement. Parents are expected to be able to help children study their online courses and replace the role of teachers.⁵⁰ Lastly, when parents and their children must stay at home continuously during the COVID-19 confinement, more frequent parent-child communication was associated with children's increased health behavior, reduced boredom, and decreased academic stress.^{50,51} Therefore, higher parental involvement showed increased odds of having good academic performance.

We found that students with higher academic self-efficacy were more likely to have good academic performance during the COVID-19 pandemic. During the COVID-19 confinement period, K-12 students lost access to everyday school life, which

created difficulties for young students. Students have no opportunities to get direct instruction that is based on different learning styles from teachers, have no opportunities for face-to-face social interactions with peers and teachers, and have no opportunities to attend physical education, music, and fine arts that do not readily lend themselves to virtual learning.⁵² Unsurprisingly, these difficulties have disturbed students' learning schedules and processes and are linked with poor academic performance.⁵³ Higher academic self-efficacy leads to specific behaviors and motivations that can encourage effective performance, possibly helping students to achieve good academic performance despite difficulties.⁵⁴

This study found that students with depressive symptoms had a lower probability of having good academic performance during the COVID-19 pandemic. The COVID-19 pandemic has adverse mental health consequences among Chinese K-12 students, including depressive symptoms, emotional symptoms, stress symptoms, anxiety, inattention, peer relationship problems, and posttraumatic stress disorders (PTSD).^{55–58} These mental health problems can affect a K-12 student's energy level, concentration, optimism, mental capability, and dependability, which can hinder his or her academic performance.⁵⁹

We found that students with high household incomes, students with higher intelligence quotients, and students who read books are more likely to have good academic performance. Our results are similar to previous studies.^{60–62} This study also found that students who reported perceived academic stress, those who were male, those who had larger family sizes, or those who played online games daily had a lower probability of having good academic performance. These findings were similar to previous research.^{63–66}

Comprehensive social surveys, such as the CFPS, provide a mass of data regarding education outcomes, economic activities, family dynamics and relationships, and health.³⁵ However, almost every analysis faces the annoying problem of missing data. Multiple imputation restores the natural variability of the missing values. Information recovery and restoring variability may reduce bias or increase precision, which results in a valid statistical inference from multiple imputation.⁶⁷ In future analyses, it will be essential to use multiple imputation to analyze a question that is too sensitive to give an answer, such as academic performance.

Policymakers and practitioners can help improve academic success and address educational inequalities among K-12 students by implementing a series of reforms. The present study has identified several factors affecting academic performance, some of which are amenable to policy changes. First, local communities and K-12 schools should develop parental involvement programs to strengthen home-school relations. Second, K-12 students should receive learning skill training to improve academic self-efficacy, enabling them to perform more effectively in uncertain or unpredictable situations. Third, the Chinese government and schools should allocate more resources to school counselor preparation for providing individual and group counseling to K-12 students, especially during crises and unexpected situations. Fourth, K-12 schools and teachers should pay attention to those with underperformance, such as male students, low-income students, and students from larger families.

Several limitations of the study should be mentioned. First, this was a cross-sectional study based on the 2020 CFPS. It had limitations in providing causal inferences that could be gained from a longitudinal study. Second, limitations of all self-reported data exist. For example, children may over-report their academic performance, leading to an inaccurate estimate of the true association between individual characteristics and academic performance. Last, the current study is limited by the information it collected; any additional variables that may affect academic performance could not be analyzed.

Conclusions

The aim of this study was to identify the factors (especially parental involvement, academic self-efficacy, and depression) associated with academic performance among Chinese K-12 students during the COVID-19 pandemic. The empirical findings suggested that parental involvement and academic self-efficacy were positively associated with good academic performance. In contrast, depression was negatively associated with good academic performance. These results can be used to design policy reforms to improve academic success and address educational inequalities.

Ethics Approval

This research has used a publicly available secondary dataset. The dataset does not contain any individual identifiers. No ethical approval was required due to the type and nature of the data used.

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Disclosure

The authors report no conflicts of interest in this work.

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