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Have the COVID-19 pandemic and lockdown affected children's mental health in the long term? A repeated cross-sectional study

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ABSTRACT

Objective The study aimed to evaluate the impact of the COVID-19 pandemic on levels of anxiety and depressive symptoms in children and adolescents.

Design Cross-sectional surveys were carried out on the mental health of children; one survey was conducted before the COVID-19 pandemic and one into the pandemic, 15 months after the school closures and implementation of lockdown and social distancing. Demographic data and COVID-19 pandemic-related data were collected from specific parent-report and self-report questionnaires.

Participants Participants included children and adolescents between ages 6 and 16 years, attending a tertiary care hospital without any diagnosed major psychiatric or chronic disorder.

Analysis Data were collected at two points (before the COVID-19 pandemic and during it) and compared. Levels of anxiety and depressive symptoms were compared and tested for statistically significant differences between these two points using appropriate statistical tests. Regression models were constructed to predict the factors affecting increased anxiety levels and depressive symptoms in the COVID-19 period.

Results 832 and 1255 children/adolescents were included in the study during the pre-COVID-19 and COVID-19 times, respectively. The median age of the participants was 10 years (IQR=4 years). The median (IQR) Spence Children's Anxiety Scale score was 24 (12) at the pre-COVID-19 point and 31 (13) during the COVID-19 pandemic (p<0.001, r=−0.27). 11% and 16% of children reported being depressed at these two-time points, respectively (p=0.004, ϕ_c=−0.063). Regression analysis showed that many factors, including the duration of smartphone use, female gender and only child status, were associated with increased anxiety or depression levels.

Conclusion A large proportion of children had elevated anxiety and depressive symptoms during the pandemic relative to before the pandemic, suggesting a need for measures to engage children in healthy habits to protect children's mental health and continuous monitoring of children during such scenarios.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ With the availability of prepandemic data, the repeated cross-sectional study design allowed us to compare the anxiety and depressive symptoms in children and adolescents during and before the COVID-19 lockdown and school closures.

⇒ The study is one of the few studies from low-to-middle-income countries on this topic with large sample size.

⇒ The data were collected hospital setting, and all of the participants were attending a hospital, which could have resulted in a sampling bias. Although it is a tertiary care hospital, majority of the patients included in the study came to us for primary care and were not referred.

⇒ We used standardised scales that are usually used for screening and evaluation purposes and not for diagnostic purposes.

⇒ A longitudinal study with a follow-up which would offer clear evidence of any fluctuation in mental health during the course of the pandemic could be a better study design for this purpose.

INTRODUCTION

Mental health is viewed as one of the most crucial parameters for a high quality of life.[1] Mentally healthy children can carry their enthusiasm and self-confidence into adulthood, giving them the ability to deal with hardships.

The COVID-19 pandemic resulted in the first-ever long-term closure of schools from March 2020 to October 2021.[2][3] The COVID-19 pandemic and its subsequent containment measures, such as stay-at-home orders and quarantine, have had a detrimental effect on the mental health of individuals of all ages.[4] In India, schools were closed from the beginning of the pandemic,

with curricula transferred to an online platform within a month. During this period, a strict lockdown with stay-at-home orders was in place. Subsequently, from November 2020 to February 2021, recreational activities such as playgrounds and sports were opened in a phased manner. Then came another lockdown due to the second wave with strict stay-at-home orders, restricting all outdoor activities once again. The schools remained completely online during this entire time.[5]

The present pandemic represents a novel, complex and multifaceted psychosocial stressor affecting children and adolescents' mental health.[6] In the wake of the closure of schools, social interactions and recreational activities outside of the home were highly restricted. Playgrounds, parks, turfs, swimming pools and dance classes were closed.[7] A lack of these activities caused by containment measures may affect children's psychological well-being, particularly of vulnerable children.[8] Parental stress might also have contributed to these children's behavioural and psychological problems.[9] Moreover, physical inactivity, dietary imbalance and poor sleeping habits probably have contributed to exacerbating this problem, notably among impoverished and marginalised children and adolescents.[10–12]

The majority of primary evidence of the impact of influenza and SARS/MERS outbreaks on mental health comes from cross-sectional study designs. These studies report significant mental health-related consequences such as psychological distress, anxiety, depression and fear.[13–15] There are rapidly accumulating repeated cross-sectional and longitudinal studies, including studies on children.[14 16–25] Though there is much literature on the psychological impacts of the pandemic, in a living systematic review of ample abstracts on this topic, only a handful of abstracts were able to offer robust data on it, with very few addressing the impact on children.[26]

This study is one of the few studies from a low-to-middle-income country. Besides this, the fact that the study was conducted in the country's worst-affected city adds to our understanding of the impact on children's mental health. This study design aimed to compare symptoms of anxiety and depression before and during the pandemic. To broaden our approach, as a secondary aim, we also tried to look at the factors significantly associated with anxiety levels and depressive symptoms during the pandemic, such as sociodemographic factors and behavioural factors.

MATERIALS AND METHODS
Study design
This study was a repeated cross-sectional study in which we included children and adolescents at two different points in time. The first sample point was between 13 February 2020 and 5 March 2020, before India's countrywide strict lockdown and school closure. The second sample point was between 1 May 2021 and 7 July 2021. The initial data collection was carried out in the context of another cross-sectional study designed in similar settings. Due to

the pandemic and lockdown state, the recruitment of subjects was temporarily suspended, and a decision was made to study the impact of lockdown on the population already participating. As a result, the final data collection was done during the second wave of COVID-19 lockdown, when social restrictions and school closures were in place for 15 months. (Physical schools were strictly closed in India from March 2020 to September 2021, shifting their routine curriculum to an online platform.) The data were collected offline through in-person interviews with observing COVID-19 appropriate behaviour.

Study setting and participants
The study was undertaken at a tertiary health centre in Mumbai, India. All children in the age group 6–16 years visiting the outpatient and in-patient department of the paediatrics department for general consultation, immunisation or refilling for medications were considered eligible for the study. Children who were previously diagnosed with any psychiatric disorder or other major chronic disorder admitted for a serious illness or used the medication that may affect the study results, such as atypical antipsychotics, were excluded. Children/adolescents (for themselves) or parents (on behalf of their children) were asked to fill out the questionnaires with the help of one of the investigators. Parent-proxy data were collected for children under the age of 11, and older children were tested with self-reports. However, considering the education, literacy, and ability to understand and respond to questions, ad hoc decisions were taken to change to a parent interview or read out the questions to the parent/child in an interview format, if necessary. The questions were read with the items in the first-person form if they were read aloud. The investigators were highly trained medical students (final year or interns) who actively participated in the meeting or translation process by discussing the scales and questionnaire. Responses only from parents who had been with their child for more than 6 months before data collection were collected.

Ethical consideration
The study was initiated after approval from instituitional ethics committee. Children were recruited for the study only after their guardian gave written informed consent, and the children themselves gave assent for participation in the study. Children who had higher than cut-off scores in the screening tests were referred to the psychiatry department for further evaluation. Anthropometric parameters (viz. height and weight) were not measured because doing so could have increased their risk of exposure to COVID-19, so appropriate social distancing was maintained.

Measurements
The questionnaires used in this study were primarily divided into four components.
1. Case record form: It was a form containing concise basic information about the socioeconomic and

demographic variables of the children and their families (like age, education, type of family, address, occupation, income, etc). It also consisted of general questions like smartphone use, the child's academic performance (in grades), recreational activity such as outdoor sports and activity/exercise. The form and additional details regarding the definitions of the terms used in this study can be found in online supplemental files 1 and 2.

2. The Spence Child Anxiety Scale (SCAS):[27] Anxiety levels were measured using the SCAS. It is a scale that uses response options, scaled using a 4-point Likert scale. It is used widely for assessing the anxiety levels of children and adolescents. This scale has 44 items, 38 of which reflect anxiety symptoms and 6 of which are positive filler items to avoid negative response bias. Within the questionnaire, items are assigned at random. Children are asked to report the frequency with which they encounter each symptom on a four-point scale: never (0), sometimes (1), often (2) and always (3). The cut-off score for significant anxiety levels varies with age and gender. This scale has been validated and widely used in various research settings, including India, with an excellent internal consistency (Cronbach's alpha=0.93).[28–31] One of the advantages of using this measure is the availability of a parent-reported version.

3. Centre for Epidemiological Studies-Depression Scale for Children (CES-DC):[32] This scale is a revised form of the Centre for Epidemiologic Studies Depression Scale. It is a depression inventory of 20 items with possible sum scores varying from 0 to 60. In children and adolescents, a score of ≥ 15 suggests the presence of depressive symptoms. The scale is found to have a high internal reliability (Cronbach's alpha=0.84) and test/retest reliability (r=0.51). This scale has been validated and widely used in various research settings, including India.[28 33] The availability of a parent-proxy version is one of the benefits of using this measure.

4. A special COVID-19 pandemic and lockdown-related questionnaire was devised by our research team, which had the questions about the following—Whether any parent is involved in anti-epidemic work/essential jobs, degree of worry of the pandemic, implementation of precautionary measures by the child, whether a close relative/friend infected with COVID-19 recently, whether a close relative/friend died with COVID-19, whether the child is ever infected with COVID-19, whether the parents yell at/beat their child, etc. The questionnaire is available in online supplemental file 3. Our research team developed the questionnaire after conducting a thorough literature review (including preprints). Those parameters, which were significant in published studies, were included in the questionnaire. We drew on relevant findings from these studies. Some questions were also suggested by colleagues in our department who were conducting similar types of studies (related to the pandemic). The investigators read out the questions rather than allowing the participants to fill out the questionnaires for convenience and avoid heterogeneity in the collected data.

All these questionnaires were made available in three languages, viz. English, Hindi and Marathi for patients to understand. The scales were either translated into native languages as described below or the translated and validated version in the native language was used, if available. The case record forms and COVID-19-related questionnaire were first designed in native languages and then translated to English. All the questionnaire components were used during both time points of the study except the COVID-19-related questionnaire, which was employed only during the COVID-19 period.

Translation

Three of the authors, who were fluent in all three languages, first translated the items from English to Marathi and Hindi (for SCAS and CES-DC). Another author produced a back-translation. The original was compared with the back-translated version, and minor differences were resolved. The translated scale was evaluated and approved by a panel of experts (two psychiatrists and a paediatrician).

Data analysis

After collecting data, the data were entered into a spreadsheet using Microsoft Office Excel 2019 (Microsoft Corporation, Washington, USA). Identifiable data were not entered into the spreadsheet.

Statistical analysis

For categorical variables, data were reported as absolute numbers and percentages. Medians with IQR were used to represent ordinal and numerical variables that did not follow a normal distribution (tested with the Kolmogorov-Smirnov test). The χ^2 test (for qualitative variables), Mann-Whitney U test and Kruskal-Wallis H test (for comparing mean ranks between two groups if the normality was rejected) were used to assess the differences between groups with continuous or ordinal variables. A $p<0.05$ (two tailed) was considered statistically significant. As appropriate, effect sizes were described as Cramer's V and r measures.

CES-DC scores were categorised into depressed or nondepressed using the cut-off value as CES-DC is a validated scale with a gender and age non-dependent cut-off of 15 points, indicating clinically significant depressive symptoms.[34] The SCAS scores were analysed as scores for the following reasons—(1) SCAS has a cut-off that varies with age and gender, (2) non-availability of standardised T-score sheets for certain age groups in our study and (3) As our primary objective was to study whether the pandemic has affected the anxiety levels in children, which was achievable with the use of scores only. Multiple linear regression and bivariate logistic regression analyses were used to assess the association between outcome variables (the reported level of anxiety and significant depressive symptoms, respectively) and potential predictors (use
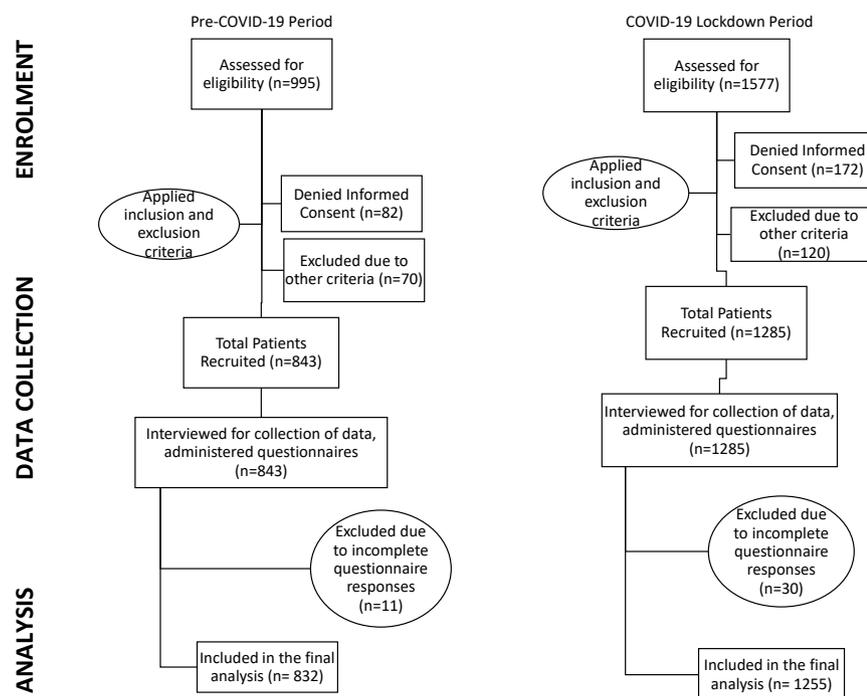
Figure 1 Participants flow diagram of patients visiting a tertiary care centre.

of a smartphone, friend or family infected with COVID-19, observing COVID-19 appropriate behaviour, etc) while adjusting for other identified explanatory variables. The forward stepwise selection algorithm was used to run models, and variables in the model were screened based on significance levels of the Wald inclusion test statistic being less than 0.05. Correlation between numerical variables was performed using Pearson's correlation test, and scatterplots were plotted. Median values and groupwise distribution of numerical data were depicted in the violin plots. Statistical analysis was performed using the IBM SPSS Statistics software (V.26.0; IBM).

Patient and public involvement
Patients or the general public were not involved in our study's design, conduct, reporting or dissemination.

RESULTS
Sociodemographic characteristics
The study included 843 children enrolled during the pre-COVID-19 study period and 1285 children enrolled during the COVID-19 lockdown period. Due to incomplete questionnaire responses during the pre-COVID-19 and COVID-19 lockdown study periods, we excluded 11 and 30 enrolled children from the analysis, respectively. The participant flow diagram of the study is depicted in figure 1. The sociodemographic characteristics of the participants are described in table 1. The median age of the children and adolescents who participated was 9 (3) years and 10 (4) years at the two points, respectively. Females constituted 53% of the total number of children and adolescents who participated. All the participants were Asian (Indians) by ethnicity. In our sample,

children (age 6–11 years) were almost two-thirds of the total participants, whereas adolescents (age 12–16 years) constituted the remaining participants. Around 86% of the participants' mothers were literate, while the fathers had a literacy rate of 94.5%. The majority of the participants resided in urban areas (84.6%) and were attending the outpatient department (77.8%) at the time of data collection. 87.26% of the data was reported by parent proxy during the prepandemic time, and 81.36% of data was parent-proxy during the pandemic time. We shifted from the child-report to the parent-report version for 286 (45.68%) adolescents. 43 (2.06%), 69 (3.3%) and 1975 (94.63%) children were attending the hospital for immunisation, refilling of medications and general consultation, respectively.

Smartphone usage
During the pre-COVID-19 period, the prevalence of smartphone use in children was 71%, which increased drastically to 95% during the pandemic (p<0.001). Moreover, the median (IQR) smartphone use per day increased from 1 (1) hour to 4 (2) hours during the pandemic (p≤0.001).

Responses to COVID-19-related questionnaire
The responses to COVID-19-related questions are depicted in online supplemental table S1. Twenty-five per cent of the children were worried 'very much' about the pandemic, with 59% being 'somewhat' worried and 16% being 'not worried'. Eighty per cent of the participants reported observing COVID-19 appropriate behaviour, including the use of face masks and sanitisers. 5.4% of the children had a history of infection with the coronavirus in the past.

Table 1 Sociodemographic characteristics of the participants

	Pre-COVID-19 (N=832)	During the lockdown (N=1255)	P value
Gender			0.39*
Male	401 (48.20%)	581 (46.29%)	
Female	431 (51.80%)	674 (53.71%)	
Age (median (IQR))	9 (3)	10 (4)	<0.001†‡
Children (6–11 years)	636 (76.4%)	825 (65.7%)	
Adolescents (12–16 years)	196 (23.6%)	430 (34.3%)	
Type of family			0.452*
Nuclear	606 (72.84%)	940 (74.90%)	
Extended	209 (25.12%)	296 (23.59%)	
Single Parent	17 (02.04%)	19 (01.51%)	
Only child			
No	750 (90.14%)	1125 (89.64%)	0.710*
Yes	82 (09.86%)	130 (10.36%)	
Education of mother			0.879*
Illiterate	118 (14.2%)	188 (15%)	
Primary school	168 (20.2%)	246 (19.6%)	
Secondary school	350 (42.1%)	513 (40.9%)	
High school and above	196 (23.6%)	308 (24.5%)	
Education of father			0.091*
Illiterate	46 (5.5%)	81 (6.5%)	
Primary school	189 (22.7%)	286 (22.8%)	
Secondary school	282 (33.9%)	364 (29.0%)	
High school and above	315 (37.9 %)	524 (41.8%)	
Report type			<0.001*†
Self-report	106 (12.74%)	234 (18.64%)	
Parent-proxy	726 (87.26%)	1021 (81.36%)	
Academic grades			<0.001*†
A grade	556 (66.83%)	915 (72.91%)	
B grade	226 (27.16%)	235 (18.72%)	
C or D grade	50 (06.01%)	105 (08.37%)	
Family income; median (IQR) (lakh INR per annum)	5 (5)	5 (4)	0.284‡
Residence			0.028*†
Urban	627 (75.36%)	997 (79.44%)	
Rural	205 (24.64%)	258 (20.56%)	
Engages in recreational activities?			<0.001*†
No	266 (31.97%)	539 (42.95%)	
Yes	566 (68.03%)	716 (57.05%)	
Smartphone user			<0.001*†
No	245 (29.45%)	65 (05.18%)	
Yes	587 (70.55%)	1190 (94.82%)	
Smartphone usage; median (IQR) (hours/day)	1 (1)	4 (2)	<0.001†‡
Inpatient/outpatient			0.707*
Outpatient	701 (84.25%)	1065 (84.86%)	
Inpatient	131 (15.75%)	190 (15.14%)	

*χ2 test.
†Significant.
‡Mann-Whitney U test.

Table 2 Anxiety using SCAS before and after the COVID-19 lockdown by the groups

	Pre-COVID-19 (median (IQR))	During the lockdown (median (IQR))	Effect size R	P value*
Overall	24 (12)	31 (13)	−0.27	<0.001†
Gender				
Male	22 (15)	24 (7)	−0.08	0.008†
Female	27 (16)	36 (8)	−0.47	<0.001†
Age				
Children (6–11 years)	23 (12)	31 (13)	−0.44	<0.001†
Adolescents (12–16 years)	26 (12)	30 (12)	−0.19	<0.001†
Residence				
Urban	25 (12)	30 (12)	−0.24	<0.001†
Rural	20 (14)	31 (15)	−0.34	<0.001†
Inpatient/outpatient				
Outpatient	24 (11)	30 (12)	−0.25	<0.001†
Inpatient	23 (14)	31 (14)	−0.34	<0.001†
Only child				
No	24 (12)	31 (13)	−0.28	<0.001†
Yes	25 (12)	26 (5)	−0.10	0.116
Income; median (IQR) (Lakh INR per annum)	5 (5)	5 (4)	−0.27	0.284
Smartphone user				
No	14 (12)	30 (23)	−0.05	0.336
Yes	27 (9)	31 (13)	−0.18	<0.001†
Smartphone usage time				
Mild (<2 hours)	24 (12)	30 (14)	−0.09	<0.001†
Moderate (3–5 hours)	25.5 (10)	31 (12)	−0.12	<0.001†
High (>6 hours)	-‡	32 (14)	−	−
Type of family				
Nuclear	25 (13)	30 (12)	−0.22	<0.001†
Extended	23 (12)	31 (14)	−0.39	<0.001†
Single parent	24 (11)	30 (14)	−0.31	0.061
Engages in recreational activities?				
No	23 (12)	30 (12)	−0.25	<0.001†
Yes	24 (12)	31 (12)	−0.28	<0.001†
Academic grades				
A grade	23 (11)	31 (12)	−0.27	<0.001†
B grade	25 (15)	31 (12)	−0.28	<0.001†
C or D grade	25 (10)	30 (14)	−0.20	0.009†

*Mann-Whitney U test.
†Significant.
‡No child fitted the criteria.
SCAS, Spence Child Anxiety Scale.

Anxiety levels of the participants before and during the pandemic

A comparison of anxiety levels using SCAS before and during the COVID-19 lockdown period is shown in table 2. There was a statistically significant difference with small to medium effect in anxiety levels between these two groups (p<0.001, effect size r=−0.27). The median values and distributions of the SCAS scores are shown in violin plots with p values from the Mann-Whitney U test (online supplemental figure S1). SCAS scores correlated weakly positively but statistically significantly with smartphone usage hours/day (Pearson's r=0.209, p<0.001) and strongly but statistically significantly with CES-DC scores (r=0.680, p<0.001). Scatterplots of the same are depicted in figure 2A,C.

Depressive symptoms in the participants before and during the pandemic

A comparison across depressive and non-depressive groups using CES-DC before and during the COVID-19
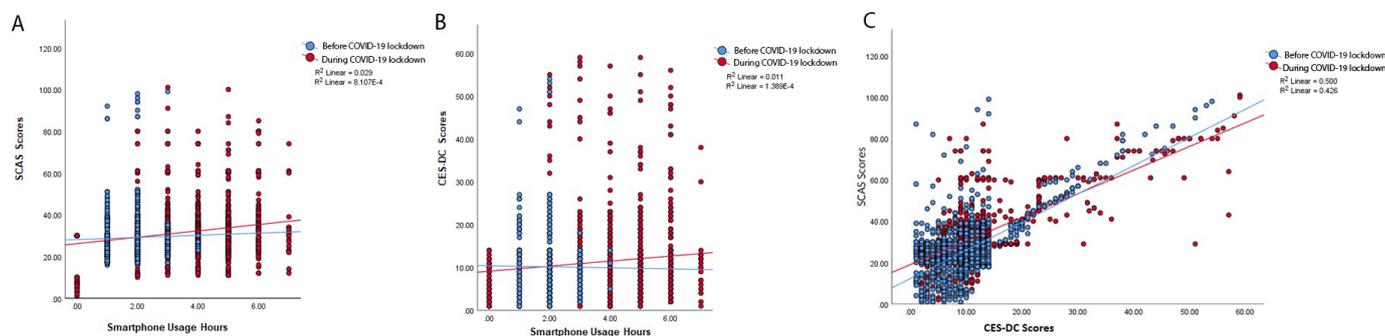
Figure 2 (A) Scatterplot between SCAS scores and smartphone use per day (in hours). (B) Scatterplot between CES-DC scores and smartphone use per day (in hours). (C) Scatterplot between SCAS scores and CES-DC scores. CES-DC, Centre for Epidemiological Studies-Depression Scale for Children; SCAS, Spence Child Anxiety Scale.

lockdown period is shown in table 3. There was a statistically significant difference with a weak effect size between groups with depression levels above the cut-off score and those under the cut-off score before and during the COVID-19 lockdown period (p=0.004, ϕ_c= 0.067). The distribution and median values of the CES-DC scores are shown in violin plots with p values from the Mann-Whitney U test (online supplemental figure S1). CES-DC scores correlated very weakly positively but statistically significantly with smartphone usage hours/day (r=0.108, p≤0.001) (figure 2B,C).

Factors associated with increased anxiety and depression during the pandemic

Regarding SCAS scores, Mann-Whitney U and Kruskal-Wallis H test analyses showed that seven variables had a significant difference in anxiety levels (p<0.05), results of which are shown in online supplemental table S2. The factors which showed increased anxiety levels during the pandemic included female gender (p<0.001), only child status (p=0.035), recreational activities (p<0.001), smartphone use (<0.001), friends or family members infected with COVID-19 (p<0.001), observing COVID-19 appropriate behaviour (p<0.001) and significant depressive symptoms using CES-DC (p<0.001). Additionally, we conducted a multiple linear regression model to analyse further the significant factors associated with children's anxiety levels. We obtained the following factors to construct a multiple linear regression model of anxiety levels: Female gender (p<0.001, β coefficient=0.491), extended family (p<0.001, β coefficient=0.111), single-parent family (p=0.001, β coefficient=0.042), smartphone use duration (p<0.001, β coefficient=0.103), family member or friend infected with COVID-19 (p<0.001, β coefficient=0.210), observing COVID-19 appropriate behaviour (p≤0.001, β coefficient=0.247) and significant depressive symptoms using CES-DC (p<0.001, β coefficient=0.416). Together, these variables explained 78.4% of the variance in the anxiety levels. (F=652.035, p<0.001, R^2=0.785, adjusted R^2=0.784) (table 4).

To evaluate the factors associated with having depressive symptoms in children, binary logistic regression analysis was performed. We identified six factors as being significantly associated with increased levels of children's clinical depressive symptoms: only-child status (p<0.001, OR=10.456), extended family (p<0.001, OR=2.754), family members or friends infected with COVID-19 (p<0.001, OR=89.571), a family member or friend died due to COVID-19 (p=0.032, OR=5.016), observing COVID-19 appropriate behaviour (p<0.001, OR=73.763), higher SCAS scores (p<0.001, OR=1.053) and smartphone usage duration (p=0.029, OR=1.186). However, no factor was significantly associated with decreased levels of children's clinical depressive symptoms (table 5).

Child abuse

A total of 113 (9%) parents reported beating their children during the pandemic, and 335 (26.7%) parents reported yelling at them.

DISCUSSION

This study on the long-term (>1 year) mental health impact of the COVID-19 pandemic and associated lockdown on children and adolescents is one of the few studies from low-to-middle-income countries. There have been quite a few studies in developed countries regarding the long-term impact and fluctuation in children's mental health symptoms during the pandemic.[35–38] In this study, we found that levels of anxiety and depressive symptoms increased considerably during the pandemic. We also found that the prevalence of smartphone usage increased significantly during the pandemic. Only-child status, extended family, family members or friends infected with COVID-19, a family member or friend died due to COVID-19 infection, observing COVID-19 appropriate behaviour, higher SCAS scores and smartphone usage duration were the factors associated with increased levels of depressive symptoms. No factor was significantly associated with decreased levels of children's clinical depressive symptoms. Increased anxiety levels were associated with female gender, extended family, single-parent family, higher smartphone use duration, family member or friend infected with COVID-19, observing COVID-19 appropriate behaviour and significant depressive symptoms using CES-DC.

Table 3 Depression using CES-DC before and after the COVID-19 lockdown by group

	Pre-COVID-19		During the lockdown			Effect size		
	Significant depressive symptoms	Non-significant depressive symptoms	Significant depressive symptoms	Non-significant depressive symptoms	df	Cramer's V (φc)	Phi (φ)	P value (χ2/ Fisher's exact test)
Overall	95 (11.15%)	737 (88.85%)	200 (15.93%)	1055 (84.07%)	1	0.063	0.063	0.004*
Gender								
Male	22 (5.49%)	379 (94.51%)	79 (13.6%)	502 (86.4%)	1	0.131	0.131	<0.001*
Female	73 (16.94%)	358 (83.06%)	121 (17.95%)	553 (82.05%)	1	0.013	0.013	0.665
Age								
Children (6–11 years)	70 (11.01%)	566 (88.99%)	132 (16%)	693 (84%)	1	0.072	0.072	0.006*
Adolescents (12–16 years)	25 (12.76%)	171 (87.24%)	68 (15.81%)	362 (84.19%)	1	0.040	0.040	0.318
Residence								
Urban	71 (11.32%)	556 (88.68%)	162 (16.25%)	835 (83.75%)	1	0.068	0.068	0.006*
Rural	24 (11.71%)	181 (88.29%)	38 (14.73%)	220 (85.27%)	1	0.044	0.044	0.343
Inpatient/outpatient								
Outpatient	80 (11.41%)	621 (88.59%)	175 (16.43%)	890 (83.57%)	1	0.070	0.070	0.003*
Inpatient	15 (11.45%)	116 (88.55%)	25 (13.16%)	165 (86.84%)	1	0.025	0.025	0.649
Only child								
No	89 (11.87%)	661 (88.13%)	161 (14.31%)	964 (85.69%)	1	0.035	0.035	0.127
Yes	6 (7.32%)	76 (92.68%)	39 (30%)	91 (70%)	1	0.270	0.270	<0.001*
Income								
Lower class (<INR 3 lakh/annum)	18 (12%)	132 (88%)	49 (21.97%)	174 (78.03%)	1	0.127	0.127	0.014*
Middle Class (between INR 3–5 lakh/annum)	29 (9.86%)	265 (90.14%)	69 (15.2%)	385 (84.8%)	1	0.077	0.077	0.035*
High Income (>INR 6 lakh/annum)	48 (12.37%)	340 (87.63%)	82 (14.19%)	496 (85.81%)	1	0.026	0.026	0.418
Smartphone user								
No	32 (13.06%)	213 (86.94%)	0 (0%)	65 (100%)	1	0.175	−0.175	0.001*
Yes	63 (10.73%)	524 (89.27%)	200 (16.81%)	990 (83.19%)	1	0.080	0.080	0.002*
Smartphone usage time								
Mild (<3 hours)	89 (11.44%)	689 (88.56%)	22 (10.73%)	183 (89.27%)	1	0.012	−0.012	0.776
Moderate (3–5 hours)	6 (11.11%)	48 (88.89%)	138 (15.97%)	726 (84.03%)	1	0.031	0.031	0.341
High (>5 hours)	–	–	40 (21.51%)	146 (78.49%)	1	–	–	–
Type of family								
Nuclear	70 (11.55%)	536 (88.45%)	124 (13.19%)	816 (86.81%)	1	0.024	0.024	0.342
Extended	24 (11.48%)	185 (88.52%)	72 (24.32%)	224 (75.68%)	1	0.161	0.161	<0.001*
Single parent	1 (5.88%)	16 (94.12%)	4 (21.05%)	15 (78.95%)	1	0.219	0.219	0.342
Engages in recreational activities?								
No	30 (11.28%)	236 (88.72%)	79 (14.66%)	460 (85.34%)		0.046	0.046	0.188
Yes	65 (11.48%)	501 (88.52%)	121 (16.9%)	595 (83.1%)		0.076	0.076	0.006*
Academic grades								
A grade	62 (11.15%)	494 (88.85%)	145 (15.85%)	770 (84.15%)		0.065	0.065	0.012*
B grade	27 (11.95%)	199 (88.05%)	38 (16.17%)	197 (83.83%)		0.061	0.061	0.193
C or D grade	6 (12%)	44 (88%)	17 (16.19%)	88 (83.81%)		0.055	0.055	0.493

*Significant.
CES-DC, Centre for Epidemiological Studies-Depression Scale for Children.

The prevalence of depressive symptoms in our study rose from 11% prelockdown to 16% during the lockdown. In the English National survey follow-up, mental health problems, including depression, rose from 10.8% in 2017 to 16.0% in July 2020.[37] In the continuation of this survey in the second wave, the prevalence of mental health disorders further increased to 17.4%.[36] In another nationwide study in Germany, depression and other mental health issues increased from 9.9% before the pandemic to 17.8% during the pandemic.[39] In other studies conducted during the lockdown due to the pandemic, the prevalence of depressive symptoms in children

Table 4 Factors associated with the anxiety levels of respondents during the COVID-19 outbreak (N=1255)

| Model | Unstandardised coefficients | | Standardised Coefficients | | |
	B	SE	Beta	T	P value
(Constant)	3.480	0.654		5.320	<0.001*
Significant depressive symptoms using CES-DC	0.673	0.025	0.416	26.469	<0.001*
Female gender	13.619	0.385	0.491	35.366	<0.001*
Observing COVID-19 appropriate behaviour	8.536	0.464	0.247	18.396	<0.001*
Friend or family member infected with COVID-19	5.963	0.414	0.210	14.387	<0.001*
Extended family type	3.620	0.436	0.111	8.299	<0.001*
Smartphone usage hours	0.917	0.118	0.103	7.770	<0.001*
Single parent family	4.771	1.490	0.042	3.202	0.001*

Forward stepwise selection procedure was employed to select the multiple linear model.
F = 652.035, p<0.001, R^2=0.785, adjusted R^2=0.784.
*Significant.
CES-DC, Centre for Epidemiological Studies-Depression Scale for Children.

and adolescents varied from 18% to 41%.[15 40 41] Many cross-sectional studies conducted during the pandemic revealed an increased incidence of anxiety during the lockdown, consistent with our findings.[15 42–44] However, they compared the prevalence in their settings to studies conducted and published before the pandemic.[15 42 43]

Table 5 Factor associated with increased levels of clinical depressive symptoms of children in the COVID-19 pandemic (N=1255)

| Variables | P value | OR | 95% CI for OR | |
			Lower bound	Upper bound
Only child status				
Yes	<0.001*	10.456	4.860	22.493
No	–	1		
Type of family				
Nuclear	–	1		
Extended	<0.001*	2.754	1.578	4.806
Single parent	0.217	3.909	0.449	34.045
Friend or family member ever infected with COVID-19?				
Yes	<0.001*	89.571	37.851	211.960
No	–	1		
Friend or family member died due to COVID-19 infection?				
Yes	0.032*	5.016	1.151	21.866
No	–			
Observing COVID-19 appropriate behaviours?				
Yes	<0.001*	73.763	14.624	372.045
No	–	1		
SCAS scores†	<0.001*	1.053	1.036	1.070
Smartphone usage hours†	0.029*	1.186	1.017	1.382
Constant	<0.001	<0.001		

Forward stepwise selection procedure was employed to select the model from variables listed in table 1 (the sociodemographic characteristics), (online supplemental table S1) (contents of the COVID-19-related information), as well as levels of anxiety and smartphone usage.
*Significant
†Continuous variables.
SCAS, Spence Child Anxiety Scale.

Our findings suggest that the prevalence of smartphone use increased significantly during the pandemic. This could be attributed to the children's social media use, video games, online schooling, lectures and digital homework. Many of the studies conducted during the lockdown period have reported the association of smartphone use and internet addiction with poor mental health,[24 45–47] in line with our study. Smartphone use leads to unhealthy behaviours such as sedentary behaviour, a reduction in time dedicated to academic learning, and the replacement of all other forms of social relations with the smartphone (favouring a state of isolation and a tendency towards introversion).[48–51] These factors were exacerbated during the pandemic, most likely contributing to increased mental health problems. On the other hand, smartphones offer the advantage of allowing youngsters to communicate with their acquaintances in real time, promoting socialisation while also delivering the benefit of distance schooling. Children may acquire information via online resources such as encyclopaedias, internet searches, dictionaries and educational applications. The benefits of smartphones cannot be overstated, and with these balanced benefits and drawbacks in mind, optimal usage of smartphones by children with parental supervision should be encouraged.

Surprisingly, 9% of the parents reported beating their children, and 25% reported yelling at them. It is thought that the pandemic has increased children's exposure to violence in their homes and communities and hampered child safety services' ability to recognise and respond to cases of abuse.[52] Throughout the COVID-19 pandemic, however, police and social service agencies have noted a decrease in reporting of such claims. School closures, which kept children at home, may have aggravated these problems.[53] The constant interaction between perpetrators and victims might have increased the violence and made reporting difficult. Preventative measures and assistance programmes are required to address these challenges.

The majority of earlier studies were conducted exclusively as online surveys during the early stages of the pandemic because social interaction was restricted during the lockdown.[14 20 24 31 54] These studies are less credible than traditional offline studies,[55] in which trained investigators interview participants one-on-one. These online studies are more prone to a substantial sampling bias due to non-probability sampling in which those who are more often in need are excluded.[56] Furthermore, these online surveys have primarily included the adolescent age groups rather than children. On the contrary, in our study, children were more than adolescents (median age 10 (4) years). The repeated cross-sectional study design allowed us to compare anxiety and depression levels in children and adolescents before and after the COVID-19 lockdown and school closures. Our study used data from the same settings before the pandemic, removing any confounding factors. Apart from these, we used two established and scientifically sound questionnaires in our study, making it one of the strengths. Every study has its own set of limitations, and ours is no exception. Because the data were collected in a hospital setting, not all of the individuals included in the study were healthy. The children who participated were visiting the hospital the mild sickness, immunisation or refilling of medications. Enrolling healthy children was impractical because schools and playgroups were closed, and we wanted to conduct an offline study, considering the sampling limitations of the other online studies. There was no way to overcome this limitation, so we included the available population. Another major limitation of the study is the lack of psychometric validation and the subjective nature of the COVID-19 pandemic-related questionnaire. Studies are necessary to develop and validate such questionnaires, which assess the general status of children within the context of the pandemic. Moreover, our study did not have a preconsidered hypothesis or study design, and there was an ad hoc change in the pandemic according to the circumstances. However, because we compared this data to children who visited the same settings before the pandemic, we believe that these biases were eliminated. Also, CES-DC assesses the depressive symptoms in the past week, and as many of the children were attending hospital, the underlying disease may have caused the depressive symptoms in the past week.

Despite these limitations, this study provides invaluable information on the psychological status of the children in the worst-affected city in India more than a year after the outbreak of COVID-19. Our findings could serve as a historical reference. Most importantly, our findings highlight the need for psychological interventions to reduce psychological impact, anxiety, depression and stress during the COVID-19 pandemic, as well as provide a baseline for evaluating prevention, control and treatment efforts by all appropriate (government and non-government) agencies for the remainder of the pandemic.

We were unable to perform a longitudinal study that would offer clear evidence of the fluctuation in anxiety and depressive symptoms during the study period, as well as the necessity for targeted public health approaches and interventions required for the well-being of the youngsters. A longitudinal study of this type may be developed to assess changes at the individual level. Additionally, the long-term effects of COVID-19 lockdown or similar situations on other psychological aspects such as sleep disturbances, loneliness and so on are unknown. Studies focusing on these aspects can be designed in the future.

CONCLUSION

Many children experienced increased symptoms of anxiety and depression during the 15-month long pandemic, lockdown and school closures that followed, suggesting the need for interventions that engage children in healthy habits that protect children's mental health and for ongoing monitoring of children in such situations to help prevent future mental health problems.

Children's increased smartphone use in the lockdown was more associated with psychosocial problems, so children and parents should be advised to encourage children to limit smartphone use. Only-child status, extended family, family members or friends infected with COVID-19, a family member or friend died due to COVID-19 infection, observing COVID-19 appropriate behaviour, higher SCAS scores and smartphone usage duration were the factors associated with increased levels of depressive symptoms. No factor was significantly associated with decreased levels of children's clinical depressive symptoms. Higher anxiety levels were associated with female gender, extended family, single-parent family, higher smartphone use duration, family member or friend infected with COVID-19, observing COVID-19 appropriate behaviour and significant depressive symptoms using CES-DC. Our findings can help develop psychological interventions for the promotion and resilience of mental health in the ongoing pandemic and similar future conditions.

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