

# Psychological and Behavioral Impact of Lockdown and Quarantine Measures for COVID-19 Pandemic on Children, Adolescents and Caregivers: A Systematic Review and Meta-Analysis

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## ABSTRACT

**Background:** During the current ongoing COVID-19 pandemic, psychological problems like anxiety, depression, irritability, mood swings, inattention and sleep disturbance are fairly common among quarantined children in several studies. A systematic review of these publications to provide an accurate burden of these psychiatric/behavioral problems is needed for planning mitigating measures by the health authorities.

**Methods:** Different electronic databases (MEDLINE, EMBASE, Web of Science, CENTRAL, medRxiv and bioRxiv) were searched for articles describing psychological/behavioral complications in children/adolescents with/without pre-existing behavioral abnormalities and their caregivers related to the COVID-19 pandemic. Only original articles with/without comparator arms and a minimum sample size of 50 were included in the analysis. The pooled estimate of various psychological/behavioral problems was calculated using a random-effect meta-analysis.

**Results:** Fifteen studies describing 22 996 children/adolescents fulfilled the eligibility criteria from a total of 219 records. Overall, 34.5%, 41.7%, 42.3% and 30.8% of children were found to be suffering from anxiety, depression, irritability and inattention. Although the behavior/psychological state of a

total of 79.4% of children was affected negatively by the pandemic and quarantine, at least 22.5% of children had a significant fear of COVID-19, and 35.2% and 21.3% of children had boredom and sleep disturbance. Similarly, 52.3% and 27.4% of caregivers developed anxiety and depression, respectively, while being in isolation with children.

**Conclusion:** Anxiety, depression, irritability, boredom, inattention and fear of COVID-19 are predominant new-onset psychological problems in children during the COVID-19 pandemic. Children with pre-existing behavioral problems like autism and attention deficit hyperactivity disorder have a high probability of worsening of their behavioral symptoms.

**KEYWORDS:** COVID-19, SARS-CoV-2, behavioral problems, child psychology, neuropsychiatric features

## INTRODUCTION

Children are less likely to be infected with SARS-CoV-2 and even if infected they usually have milder symptoms or even remain asymptomatic. But they are not immune and indifferent to the psychological adverse effects of the pandemic and quarantine measures. Children as young as 2 years are aware of the changes around them and get affected by it [1]. It has been shown that children are fearful about the infection of self and family members, sometimes didn't like the strict social distancing/quarantine measures, felt anxious about uncertainties regarding when the pandemic will end, feel isolated due to prolonged and widespread closure of the schools, parks, theaters and other public places and lack of opportunity to play outdoor games [2–5]. The parents, who are also equally stressed out and added to the worsening of these behavioral and psychological problems in children [2]. Previously few studies found that anxiety, depression, irritability, mood swings, inattention and sleep disturbance are fairly common among quarantined children [3, 4]. Studies performed in past during epidemics caused by SARS, Ebola virus and Middle-East respiratory syndrome have shown a high prevalence of adverse psychological consequences in both adults and children during these challenging times [5]. During this COVID-19 pandemic, also some investigators have completed clinical studies in this regard and have demonstrated that children and adolescents, whereas remaining in lockdown/under quarantine show increased anxiety and depression [6–17]. Apart from worrying a lot and showing fear of affected by the illness, they were also found to be worried about their family members [6–10]. Similarly, students also suffered additional psychological stress due to

interrupted academics and uncertain future [9–12]. The caregivers were also found to be increasingly worried about the impaired behavior and psychological symptoms are seen in their children during this pandemic [16, 17]. Although a large number of narrative reviews and even several studies from different parts of the globe have tried to address this problem, the prevalence and severity of these psychopathologies seem to vary widely. Public health authorities and clinicians need to have an accurate estimate of the nature, severity and extent of these behavioral abnormalities and psychopathologies, both in typically developing children and children with behavioral abnormalities, as well as their caregivers. But no systematic review of these publications has been conducted till now to provide an accurate burden of these psychiatric/behavioral problems, which will help planning mitigating measures by the health authorities. Moreover, some of the individual studies often had a flawed methodology and bias in reporting the results. Thus, careful interpretation of the quality of these studies also seemed to be necessary before generalizing their results to various communities and countries. Hence, we performed this systematic review to collate all reports describing the likely effects of the COVID-19 pandemic and quarantine measures on children and adolescent's mental health, psychological wellbeing and behavioral profile from the currently available literature. Accordingly, the primary objective of this systematic review was to provide a pooled estimate of the prevalence of various psychological and behavioral symptoms/disorders in children and adolescents up to 18 years of age during this pandemic. The secondary objective of this review was to provide a pooled estimate of the behavioral profile of children with pre-existing

behavioral co-morbidities like autism spectrum disorder and attention deficit hyperactivity disorder (ADHD). The review also intended to determine the pooled estimate of the prevalence of various psychological problems in caregivers of children hospitalized/quarantined during the pandemic. We also explored the factors associated with the occurrence/severity of these psychiatric/behavioral problems in children.

## MATERIALS AND METHODS

### Search methods

A meta-analysis of observational studies in epidemiology and Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines were followed while conducting the study. A predefined search strategy was developed first. Three investigators performed independently a literature search in MEDLINE/PUBMED, Web of Science, EMBASE, CENTRAL (Cochrane central register of controlled trials), medRxiv and bioRxiv for original articles between 1 December 2019 and 15 August 2020, without using any language restrictions. The search strategy was targeted to include children aged  $\leq 18$  years. The terminologies used were divided into three basic groups: study population (children/pediatric/infant/adolescent/child), terms describing or related to COVID-19 (also SARS-CoV-2, coronavirus and 2019 nCoV), and terms describing psychological/behavioral symptoms (also anxiety, depression, stress, fear, worry, neuropsychiatric, sleep problem, insomnia, distraction, inattention etc.). Using these MeSH terms specific search strategies were developed for each search engine. The electronic search was later supplemented by a manual search of the references of the included articles, to identify additional cases.

### Eligibility of studies

Only original articles describing prospective/cross-sectional studies, with/without comparison and control arms, enrolling children up to 18 years and their caregivers were included, only if they have a sample size of 50 or more to provide a true pooled estimate. Small case series, case reports and retrospective studies were excluded, as also articles describing

secondary research like systematic reviews, narrative reviews, brief commentaries, perspectives, editorial communications and scoping reviews, research articles without available full texts, book chapters, conference papers, theses, abstract-only articles, studies describing other serotypes of coronaviruses and animal studies. The studies providing data on prevalence and variables associated with psychological/mental wellbeing were only included. Studies that did not evaluate the psychological impact and stigma related to quarantine in children and adolescents, duplicate/overlapping sample population, non-peer-reviewed articles and unreliable data sets were also excluded.

Each of the articles included underwent quality check as per a predefined set of criteria and validated guidelines. Independently two researchers first screened the title and abstract to select the articles. Subsequently, the reviewers went through the full text of all articles to determine the prevalence of various psychological/behavioral/emotional problems and the factors associated with them. The studies were divided into three categories, one describing previously healthy children, one describing children with pre-existing behavioral co-morbidities, and one describing the impact on caregivers confined with the children in home/hospital and they were analyzed separately to ensure comparability between the studies pooled in meta-analyses and to provide a true pooled estimate.

### Outcome measures

The primary outcome measure was the proportion of children and adolescents having depression, anxiety, irritability, fear and other psychological/behavioral symptoms. Secondary outcome measures were the proportion of children with pre-existing behavioral abnormalities like autism spectrum disorder and ADHD who developed worsening of their behavioral symptoms and developed the above-mentioned behavioral problems. Other secondary outcomes were the proportion of caregivers confined with children, who developed various psychological problems and factors associated with various psychological problems in children.

### Study selection, data extraction and assessment of the risk of bias

A predesigned, standardized, well-structured proforma was developed for data extraction. Two investigators independently reviewed the eligible articles and extracted data from their full text. The extracted data included as much information available from the following: the number of children and adolescents/caregivers, demographic details of sample population, frequency and prevalence of each of the behavioral/psychological problems, measurement scales used for assessing presence and severity of these problems, mode of administration of these measurement scales or collection of information (online survey, telephonic review and direct face-to-face interview), person providing response to queries by the investigators in these studies (children, parents and other caregivers), sleep disturbances, compliance with quarantine measures, regressive/adaptive behaviors, factors associated with occurrence and severity of these mental health problems, perceived and availed helps from health care professionals, prevalence and degree of worsening of pre-existing behavioral abnormalities and all these variables in the control/comparator arm also, apart from the study site, study period, sample size, study design and other details of study method. A third independent investigator rechecked the completeness and accuracy of extracted data. If both investigators disagreed on some topic, then a consensus decision was achieved by discussing with this third investigator. Every effort was made to prevent duplication of data and every participant included in the final analysis was ensured not to be part of another study.

Newcastle Ottawa scale was used to assess the quality of the included studies. The risk of bias in the included study was determined by two investigators independently using GRADE's approach and any dispute was settled by discussing with a third investigator.

The following scoring system was used: good quality: at least 3/4 stars in selection domain, 1/2 stars in comparability domain and 2/3 stars in outcome/exposure domain; fair quality: 2 stars in selection domain, 1/2 stars in comparability domain, 2/3 stars in outcome/exposure domain; and rest of the studies as poor-quality studies.

### Data synthesis and statistical analysis

Appropriate descriptive statistics were used to represent various parameters and wherever feasible, pooled estimate, with 95% CIs of these parameters were estimated. Categorical variables presented as frequency (percentage) and 95% CI, whereas continuous variables were presented as mean with SD or median with interquartile range. Meta-analysis of data regarding various parameters was performed using STATA software. We utilized a random-effect model assuming that frequency of different psychological complications and other parameters across different studies will be variable while pooling data of individual studies. Heterogeneity in studies was assessed by utilizing Higgins and Thompson's  $I^2$  method and chi-square test on Cochran's  $Q$  statistics. Egger's test was used to assess the presence of publication bias.

## RESULTS

### Results of the search

After a primary search, a total of 219 publications were retrieved. Among these, 68 were duplicates and hence removed accordingly. The eligibility of the remaining 151 papers was evaluated initially and 73 irrelevant articles were excluded according to the title, article type and abstract (PRISMA flow chart: Fig. 1). Seventy-eight articles were selected for full-text review. Ultimately, 15 studies were included in the final analysis, including 22 996 participants [2–4, 6–17].

### Characteristics and risk of bias of included studies

Out of the 15 studies, 10 were of fair quality, and 5 were of good quality. There was a moderate risk of bias in 4 studies and a low risk of bias in 11 studies according to the ROBINS-I tool. None of the studies were of poor quality (Table 1). The certainty rating for the level of evidence provided in the studies was of moderate level of evidence for all studies. No significant publication bias was found.

### Study designs and scales used

Among the included studies, the study design was cross-sectional, with comparison arms (controls)

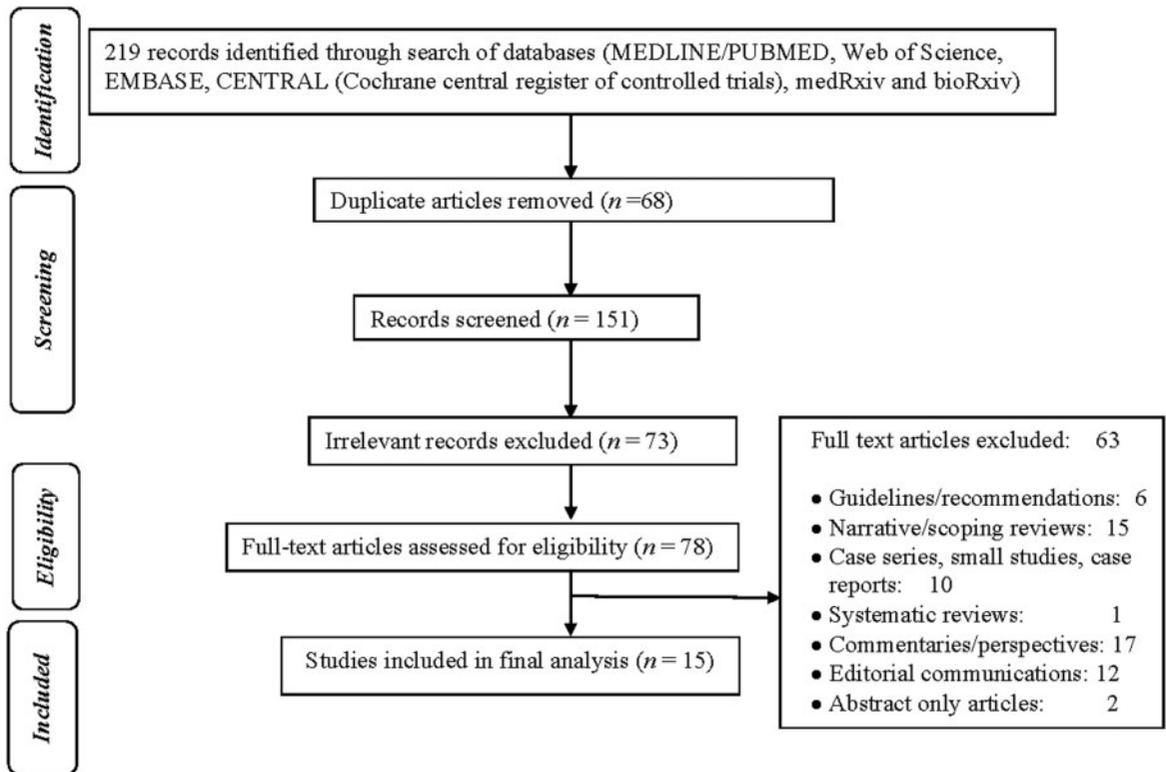


Fig. 1. PRISMA flow diagram of the study selection process.

TABLE 1. Details of studies included in systematic review

Author	Country	Patients ( $n$ )	Study design	Study population	Study quality
Bobo <i>et al.</i>	France	533	Cross sectional	ADHD children	Good
Colizzi <i>et al.</i>	Italy	527	Cross sectional	Autistic children	Good
Duan <i>et al.</i>	China	3613	Cross sectional	Healthy children	Good
Zhou <i>et al.</i>	China	8079	Cross sectional	Healthy students	Good
Orgilés <i>et al.</i>	Italy and Spain	1143	Cross sectional	Healthy children	Good
Hou <i>et al.</i>	China	859	Cross sectional	Healthy children	Good
Jiao <i>et al.</i>	China	320	Cross sectional	Healthy children	Good
Pisano <i>et al.</i>	Italy	5989	Cross sectional	Healthy children	Good
Saurabh <i>et al.</i>	India	121	Cross sectional	Healthy children	Good
Lee <i>et al.</i>	Hong Kong	757	Cross sectional	Healthy children	Fair
Avila <i>et al.</i>	Brazil	289	Cross sectional	Healthy children	Good
Senkalfa <i>et al.</i>	Turkey	135	Cross sectional	Healthy and CF children and their mothers	Fair
Yeasmin <i>et al.</i>	Bangladesh	384	Cross sectional	Healthy children	Fair
Yuan <i>et al.</i>	China	50	Cross sectional	Parents	Fair
Kim <i>et al.</i>	Korea	62	Cross sectional	Parents	Fair

only in two studies. Outcome measures were assessed by using online questionnaire-based surveys in 13 out of 15 studies, whereas direct interviews of students were performed only in two studies. The questionnaire designed for the online/interview-based survey was prepared specifically by the investigators, suited for the COVID-19 situation in seven studies, and rest eight studies used various questionnaires like the Patient Health Questionnaire, Generalized Anxiety Disorder scale, the Impact of Events Scale-Revised, Diagnostic and Statistical Manual of Mental Disorders criteria, Spence Child Anxiety Scale (SCAS), Child Depression Inventory, State and Trait Anxiety Inventory, Children's Anxiety Questionnaire and the Numerical Rating Scale, Child Behavior Checklist, Short Version of Smartphone Addiction Scale, Coping Style Scale and Internet Addiction Scale.

### Summary of the included studies

#### *Studies assessing the effect on children with pre-existing behavioral abnormalities*

Bobo *et al.* [6] performed an anonymous online survey to determine abnormalities in mental health status including 533 French children and adolescents with ADHD during the confinement period due to COVID-19. According to the parents, the majority of participants experienced either a stable general psychological state or better wellbeing. Another constructive element was parents also became better aware of their children's difficulties. School and academic aspects were cited as the most predominant factor determining the emotional state of ADHD children before confinements due to the COVID-19 pandemic. There was the interruption of the 'tailor-made' rhythm and face-to-face schooling of the pre-COVID-19 era, leading to a reduction in anxiety. They also had improved self-esteem due to a reduction in negative signals sent back to the child due to ADHD and decreased academic and social constraints. Even a group of children found the family environment more conducive for their chores and had improvement in their inattention. Relaxation of time constraints, more and better quality of substantial family time led to a decrease in symptoms of agitation. However, most children had a feeling of confinement and lack of freedom to explore in the

home. The parents felt that not only the period of confinement was an 'emotional roller coaster' for the child, but they also had more sleep problems, aggressiveness and core ADHD symptoms. But a proportion of participants developed attitudes of opposition and avoidance due to exposure to the volume of tasks and abandonment of accommodations. The subgroup of children whose condition deteriorated suffered from both behavioral and emotional difficulties. Around 34% of children each had no significant change in behavior and worsening of behavior, whereas 31% had some improvement in behavior.

Colizzi *et al.* [4] investigated the impact of the COVID-19 pandemic on 527 autistic children by using an online survey filled by parents and guardians. Around 94% of families felt it was a challenging period. Around 75%, 78%, 23% and 31% of parents faced difficulties managing structured activities, free time, child's meals and autonomies, respectively during daily routine. Around 41% and 35% of children had an increase in the frequency and intensity of behavioral problems, respectively. The presence of prior behavioral co-morbidities was associated with an increase in the frequency and intensity of behavioral problems during the lockdown. Only 1.5% of participants required a visit to emergency care, but overall 19% of parents needed to contact their child neuropsychiatrist. Around 30%, 10%, 7%, 9% and 7% of parents felt the need for in-home health care support, center-based health care support, in-hospital health care support, loosening of quarantine restrictions and ending of lockdown.

#### *Studies assessing the effect on previously healthy children*

Duan *et al.* [3] studied the psychological effect of COVID-19 by enrolling 3254 adolescents and 359 children online. About 91% were concerned about the pandemic and 54% and 35% of participants considered that their learning and graduation, respectively were affected by the pandemic. Both children and adolescents had significant anxiety ( $19.79 \pm 15.79$ ) and ( $29.27 \pm 23.87$ ), respectively as measured by SCAS. Around 22% and 7% of participants were found to be suffering from depressive and internet addiction symptoms and 10% and 13% of males and females had symptoms of smartphone addiction.

Adolescents had more anxiety symptoms than children. Significant factors associated with increased levels of anxiety were female gender, residency in an urban region, emotion-focused coping style, implementation of the precaution and control measures, clinical depression levels, friend or family member infected with COVID-19, and non-medical occupation of the others. Significant factors associated with heightened levels of depression were internet/Smartphone addiction and affected friends/family members in the recent past. Factors associated with reduced levels of depressive symptoms were fewer hours per day spent on the internet per day before the pandemic and problem-focused coping style.

A large online survey conducted in China by Zhou *et al.* [7] including 8079 students aged 12–18 years showed that 43% and 37% had depression and anxiety symptoms respectively (26%, 15% and 2% had mild, moderate and severe depression, respectively, whereas 27%, 7% and 3% had mild, moderate and severe anxiety, respectively). Females, residents of rural areas and students in senior school and higher grades had more depressive and anxiety symptoms, while higher scores for COVID-19 knowledge, projections of the COVID-19 trend, prevention and control measures were protective for depressive and anxiety symptoms.

Orgilés *et al.* [8] performed a survey on 1143 parents in Italy and Spain to study the emotional impact of quarantine on children and adolescents aged 3–18 years. Around 85% of the parents felt worsening of the emotional and behavioral symptoms of their children during the quarantine. The most frequent problems were: difficulty in concentrating (76.6%), irritability (39%), boredom (52%), restlessness (38%), feelings of loneliness (31%), nervousness (38%), uneasiness (30%), worries (30%), anxiety (28%), anger (25%), increased reluctance (24%), sadness (23%) and fear (23%) of COVID-19. Children spent more time watching screens including iPads, TVs, mobiles or computers, less time performing physical activity, and had increased hours of total sleep duration. Although 35% and 39% of patients were very much stressed and somewhat stressed, only 25% of parents did not feel stressed about their child. Around 55% and 33% of parents

felt that the impact of the pandemic was very much serious and somewhat serious, whereas only 11% of parents felt that the impact was not serious.

Hou *et al.* [9] performed a cross-sectional study in rural China on 859 high school students to investigate the suicidality and mental health problems among senior high school students during this pandemic time and explore various potential influential factors. Around 85%, 71% and 54% had symptoms of anxiety, depression and post-traumatic stress disorder respectively. Around 31% and 7% of participants had suicidal ideation and reported suicidal attempts, respectively. Female participants and those with poor academic records were associated with increased risk for all these psychiatric problems, whereas the left-behind children are at increased risk for depression. Higher exercise frequency was relatively protective against depression and anxiety. Similarly having siblings was a protective factor against suicidal ideation, but somehow predisposed towards having post traumatic stress disorder.

An online questionnaire-based study performed early during the pandemic in February 2020 in Shaanxi province of China by Jiao *et al.* [10] studied behavioral and emotional reactions in 320 children and adolescents aged 3–18 years. The study found that clinginess (36%), irritability (31%), distraction/inattention (32%) and fear of asking questions/for the health of relatives (22%) were the most common behavioral and psychological problems in participants. Other common problems were excessive worry (29%), obsessive request of updates (28%), sleeping problems (21%), poor appetite (18%), fatigue (16%), nightmare (14%), discomfort and agitation (13%). Children in the younger age group (3–6 years) were more likely to have clinginess and fear for relatives, whereas old age children (6–18 years) were more likely to show inattention and persistent inquiry.

Pisano *et al.* [11] in Italy performed a cross-sectional study including 5989 children aged 4–10 years using a 12-item ad-hoc questionnaire including three areas (four questions for each domain: regressive, oppositional behaviors and adaptation behaviors). The study found that around 26% of children started having excessive clinginess and

request to sleep in parent's beds, 3% of children developed new-onset enuresis, 5.5% had worsening of vocabulary and 18% developed excessive and inappropriate fears. Around 54%, 43%, 31%, 21% and 19% developed irritability, listless behavior, anxiety, mood swings and sleep problems.

In India, Saurabh and Ranjan [12] interviewed 121 children and adolescents regarding their compliance with quarantine measures and psychological distress during the quarantine period and compared the same with 131 non-quarantined children and adolescents. Overall, only 7% of children were compliant with quarantine measures (17% for community protective measures and 10% for household protective measures). Anxiety, helplessness and fear were highly prevalent among quarantined children (68%, 66% and 61%, respectively) and the difference between the degree of psychological distress in these children and non-quarantined children was significant ( $p < 0.001$ ). Most children attributed this distress to the loss of father's job, financial losses of family and unavailability of basic amenities of life.

In a study conducted in Hong Kong, 20% out of the 757 students had maximum levels of stress (10/10) after their Diploma of secondary education examination was suddenly differed. The average level of stress as ranked by students was also 8.1 out of 10, suggesting a high level of stress. The authors attributed this to the fact that the students were forced to continue studying at home for months, amidst the uncertainties brought about by the outbreak, without getting proper support from teachers or school. Many students also felt staying healthy was another stressor during this outbreak [13].

Garcia de Avila *et al.* [14] found that 21.8% of children aged 6–12 years suffered from anxiety, out of the 289 participants in an online cross-sectional survey reported by guardians. Anxiety was higher among children having parents with essential jobs and those who were social distancing without parents, more persons living together in the home, and lower education level of guardians. On the contrary, Pinar Senkalfa *et al.* [15] found that children with cystic fibrosis ( $n = 45$ ) did not have a higher level of anxiety as compared with healthy controls ( $n = 90$ ), but mothers of children had a higher level of anxiety as compared with mothers of healthy

children and it was further higher for those mothers, whose children had chronic pseudomonas infection. Yeasmin *et al.* [2] in an online parent-based cross-sectional study found that out of 384 children aged 5–15 years, 57% had anxiety, depression and/or sleep disturbance (31%, 19% and 7% had mild, moderate and severe disturbances).

#### *Studies assessing the effect on caregivers*

Even the parents of children admitted for various reasons during this epidemic period had more severe anxiety and depressive symptoms as compared with their counterparts in the non-epidemic period ( $p < 0.001$ ), in a study conducted by Yuan *et al.* [16], in which they compared 50 parents in each group. Significant depression and anxiety were found in around 42% and 48% of parents respectively, whose children were admitted during the pandemic period.

Kim *et al.* [17] studied behavioral and psychological responses and stressors of 72 caregivers quarantined with 62 hospitalized children after close contact with the COVID-19 affected case. About 90% of the caregivers had feelings of worry nervousness and worry, 91%, and 86% of parents feared the risk of infection to their child and themselves, respectively. A minority proportion (4.2% and 1.4%) even developed suicidal and homicidal ideations, respectively, which was worrisome. Around 7% of caregivers required psychotropic medications during this short period of institutional quarantine and even one caregiver required admission to a psychiatric ward because of frank suicidal ideations. Worrying (94.4%), nervousness(90.3%), anger(31.9%), sleep disturbance (30.6%), weeping(30.6%), feeling the loss of control for external events (23.6%), acting out(9.7%), avoidance (8.3%), depression (8.3%), hopelessness (2.8%), panic attack(2.8%) and refusal to test for SARS-CoV-2 (1.4%) were the various psychological problems detected in the caregivers.

#### **Quantitative review**

Out of these 15 studies, 11 studies described the behavioral, emotional and psychological problems of children and adolescents as a result of pandemic and/or lockdown/isolation measures, including 21 689 participants. Two studies enrolled 1060 children with behavioral abnormalities (one study

enrolled 533 children with ADHD and another study enrolled 527 children with autism spectrum disorder). Three studies explored the effect of pandemic/quarantine measures on the parents (one study also described anxiety in children in the same study) when they were forced to stay in hospital/quarantine measures during the pandemic. These three studies enrolled a total of 257 caregivers. Although most studies enrolling children without behavioral abnormalities described the self-report measures by children themselves, studies exploring children with ADHD/autism mainly relied on parent reports regarding the child.

Subsequently, we met-analyzed the results of these studies to determine the exact pooled estimate of the prevalence of various psychological and behavioral problems in children and their caregivers, to provide a comprehensive estimate of the impact of the COVID-19 pandemic, irrespective of different geographical distribution.

Overall, 34.5%, 41.7%, 42.3% and 30.8% of children were found to be suffering from anxiety, depression, irritability and inattention. Although the behavior/psychological state of a total of 79.4% of children was found to be affected negatively by the pandemic and quarantine, at least 22.5% of children were found to have a significant fear of COVID-19,

and 35.2% and 21.3% of children had boredom and sleep disturbance. Similarly, 52.3% and 27.4% of caregivers developed anxiety and depression, respectively, while being in isolation with children (Table 2). There was no significant difference between males and females in the prevalence of these psychiatric problems, although only a few studies explored this variable. Overall, the need for professional support as perceived by parents was more for children with behavioral co-morbidities (autism or ADHD) as compared with previously healthy children ( $p = 0.01$ ).

## DISCUSSION

The current systematic review provides a quantitative estimate of the psychological and behavioral impact of the current ongoing COVID-19 pandemic in children. Since many countries are now attempting unlocking measures, child psychiatrists/psychologists need to intervene at this point to minimize long term consequences. In the countries where lockdown measures have not been completely removed, the psychiatrists and behavioral pediatricians need to identify these children with behavioral problems and provide proper behavioral/psychological intervention through telephonic consultation [18, 19].

**TABLE 2. Pooled estimates of the prevalence of various psychological problems in children and caregivers during the COVID-19 pandemic and quarantine**

Psychological symptoms in children ( $n = 21\ 330$ )	Pooled estimates % (95% CI)	Heterogeneity ( $I^2$ %)	$p$ -value for $I^2$
Anxiety	34.5% (33.8–35.1%)	45	0.018
Depression	41.7% (40.8–42.3%)	36	0.02
Irritability	42.3% (39.4–45.7%)	31	0.04
Boredom	35.2% (32.9–39.1%)	35	0.03
Sleep disturbance	21.3% (18.7–24.1%)	39	0.04
Excessive fear	22.5% (19.3–25.4%)	41	0.02
Inattention	30.8% (27.9–32.8%)	29	0.047
Overall worsening of behavior/ any psychological symptoms	79.4 % (71.8–88.3%)	52	0.001
Psychological symptoms in care- givers ( $n = 257$ )			
Anxiety	52.3 % (42.4–60.7%)	61	0.001
Depression	27.4 % (19.4–35.8%)	34	0.037

Because of this unprecedented situation, schools of the children are closed, examinations have been postponed, children have been confined to the home and they can't plan outdoor play activities with their peers due to social distancing norms, places for recreation like parks, shopping malls and theaters are closed. There is a large number of COVID-related deaths occurring in the community and a feeling of uncertainty and fear has loomed over everybody. All these adverse conditions in the immediate family environment could probably predispose a lot of children to develop behavioral problems. The review identified that anxiety; stress, sadness, boredom, depressive symptoms, sleep disturbance and fear for the situation are the predominant behavioral/emotional problems.

Having said that, it seems currently impossible as health authorities are now mainly concerned about handling the critically sick patient and containing the wildfire spread. Moreover, a large number of people have lost their job and regular earnings due to the pandemic, thereby disrupting their healthy financial family environment [20].

Anger, post-traumatic stress disorder and emotional exhaustion are also found to be very common in our review in various studies. At least 70–90% of children were found to have worsened in at least some aspects of their behavior, which is worrisome for the clinicians. Notably, Saurabh and Ranjan [12] have shown that although the children who are quarantined showed more psychological co-morbidities, even the non-quarantined children had a relatively higher incidence of these problems, as compared with the studies in children in the pre-COVID era. Thus, it seems, the COVID-19 pandemic as such has a definite adverse impact on the psychological profile of children, which is further aggravated by quarantine measures.

One interesting aspect is that smartphones and social media, which was previously despised by most parents, have now become the only media for entertainment, information and education for children. Although many authors are favoring their use in mitigating the stress and depression of children, the parents need to have control over the judicious and reasonable use of electronic media and content of the programs their children are viewing [21, 22].

Online classes have been initiated in many schools and innovative measures to make online learning interesting can help many children. Indoor games, which are enjoyable and educational at the same time, are also welcome [23]. Positive reinforcement and healthy emotional interaction between family members is another simple yet effective step to relieve the stress of children. Despite all these measures, many children would need structured psychological intervention in the upcoming days [20, 23]. Our review will most probably give a reasonable estimate towards the target psychological disorders and their relative burden in these children; the clinicians are going to come across in the next few months. The demand for psychotropic medications and sessions for behavioral/psychiatric counseling is likely to increase in the future [1].

Our review showed some geographical and temporal differences in the relative prevalence of various psychological problems in children. Most studies from Asia showed a higher prevalence of psychological morbidities as compared with other developed countries like Italy and Spain [8, 11]. The studies were done in the earlier stage of the pandemic also included a high proportion of participants with uncertainty and fear [8, 21].

The proposed interventions to mitigate these effects can be divided into few subdivisions like educational interventions (effective online learning, provision of psychosocial support and healthy lifestyle motivation through educational portals), information dissemination (accurate information, limited but adequate exposure with news, discussion with children about what they heard or saw), behavioral therapy complemented with sleep hygiene, exercise and healthy eating, utilizing telehealth to provide counseling/support to children at risk and to help parents coping with family issues, ensure positive parenting and social connectivity and seeking the help of professional when needed. Schools and teachers also need to be actively involved in achieving all these targets [22]. Education and public health officials need to work together to decide on the content of effective online learning, minimizing exposure to social crowding and ensuring a safe return to school at the earliest possible [22].

Children tend to worry more when they are kept in dark about what is happening in the community and often vent out their worry in form of anger, distraction and temper tantrums. Thus, making them understand about the pandemic and lockdown norms using age-appropriate language and understanding is a challenge to the parents. It is highly essential to acknowledge and validate the thought, feelings and reactions of children and provide them with the appropriate emotional scaffolding they need during the quarantine period [24]. Cognitive-behavioral therapy incorporating culturally sensitive interventions, enjoyable activities, problem-solving skills and tasks to address avoidance behaviors are also required in a proportion of severe cases [24].

In many low-medium income countries schools are the only feasible mental health strategy to reach out to a large number of children during this pandemic and thus WHO is encouraging the 'health-promoting school' global strategy to mitigate the long-term adverse mental health consequences in the post-quarantine period. On the other hand, positive parenting and problem-focused coping strategies can convert this crisis into an opportunity. Parents can use this period as a novel opportunity to spend quality time with their children, improve positive interaction between parents, children and siblings and strengthen family bonds. Consistent with the above facts the ADHD children found the home environment less challenging and many of them had improvement in symptom profile [2].

However, almost all parents of autistic children found it a challenging situation, and the majority of these children had worsening of behavioral abnormalities. A significant proportion of their parents needed the help of professionals as compared with the parents of children with ADHD. Overall, the need for the help of psychiatric professionals was relatively higher for children with prior behavioral co-morbidities as compared with the general community [25].

Imran *et al.* [26] performed a systematic review in this regard in the early stage of the pandemic and included only three studies on COVID19 in a descriptive review. This review raised the same issues of various psychological problems that were addressed more objectively with exact information

on their public health burden. However, many issues like the perception of students and the perception of parents were not addressed in that review [27]. Thus our review is the first global perspective including >20 000 children across various countries revealing the real-world impact of the on the behavior and psychiatry of children. This review is likely to help the regulating authorities in deciding the future strategy as many countries are in different phases of the unlocking process, breaking the misery of home confinement, even allowing small to moderate social gatherings and reopening schools and public places. Although these measures carry a definitive risk of the second wave of the pandemic, the public health authorities need to take a tough but reasonable decision considering the benefits and harms of discontinuing quarantine measures [27]. Last, the results of our review also indicate the requirement for a structural stress management helpline for parents and secondary school students as a novel finding. At the same time, the children who had family members suffering from COVID-19 or who had lost their near and dear ones to the pandemic need more intensive behavioral and psychological support [27–29].

#### **Recommendations based on findings of our systematic review**

Most of the above-mentioned problems can be taken care of by audio/video counseling, hence, an urgent need for public health authorities to provide appropriate educational and recreational measures as well as psychological interventions through telephonic review. Psychologists, psychiatrists, pediatricians and community health practitioners need to join hands at this challenging time, to reach the children at every corner of the community, without violating the lockdown and social distancing norms. In many countries, the lockdown measures have been made liberal and are being replaced by unlocking measures as in India. This could help the key health care stakeholders to expedite their effort in identifying the children who require counseling/psychotropic medications and institute mitigating measures at the earliest possible. At the same time, in some countries, the second and third wave of new COVID-19 cases have forced governments to impose lockdown measures again. Thus, child health practitioners and

psychiatrists will probably face an uphill task to normalize the psychological impact of this pandemic on children in upcoming days.

### Limitations

Our review has several limitations. First, the reliability of pooled estimates might be compromised due to different study designs of included articles, separate measurement tools in different studies for a particular psychiatric symptom, variable study outcomes and subjectivity of interpretation of the behavior of children by parents. Second, even after careful interpretation, we could not differentiate what proportions of these disorders are due to the effect of disaster, disease or disaster containment measures, or synergistic effects of both. Third, the parents themselves are found to be suffering from stress and psychological problems and thus their perception might not be the true reflection of the situation. Some of the studies included were not of good quality and the heterogeneity of the studies was high. Direct assessment by child psychiatrists was not part of most of the studies, so the problem burden projected in this review might be the tip of the iceberg only and the real picture of psychological stress might be more pervasive and worrisome.

### CONCLUSION

Anxiety, depression, irritability, boredom, inattention and fear of COVID-19 are predominant new-onset psychological problems in children during the COVID-19 pandemic and while confined in quarantine. Children with pre-existing behavioral problems like autism and ADHD have a high probability for worsening of their behavioral symptoms. To mitigate this far-reaching and significant negative impact on the psychological wellbeing of children, multifaceted age and developmentally appropriate strategies are required to be adopted by health care authorities.

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