

Effects of COVID-19 pandemic on mental health of children and adolescents: A systematic review of survey studies

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Abstract

Objective: Mental health problems among children and adolescents are increasingly observed during the outbreak of COVID-19, leading to significant healthcare concerns. Survey studies provide unique opportunities for research during this pandemic, while there are no existing systematic reviews in this setting. The objective was to summarize existing survey studies addressing the effects of the current COVID-19 pandemic on the mental health of children and adolescents.

Methods: For this systematic review, we performed an electronic search in multiple databases from December 2019 to December 2020. The quality appraisal of the included studies was performed with the Critical Appraisal Skills Programme Qualitative Checklist. Because of the high methodological heterogeneity between studies, a narrative synthesis of the qualitative data was used.

Results: In total, 35 survey studies with 65,508 participants, ranging from 4 to 19 years of age, are included in this review. Anxiety (28%), depression (23%), loneliness (5%), stress (5%), fear (5%), tension (3%), anger (3%), fatigue (3%), confusion (3%), and worry (3%) were the most common mental health issues reported. Children and adolescents with psychiatric and/or developmental disorders, such as severe obesity, chronic lung disease, attention deficit hyperactivity disorder, cystic fibrosis, and obsessive-compulsive disorders, were especially vulnerable to the mental health effects of the COVID-19 pandemic. Age, gender, psychological quality, and negative coping strategies were identified as risk factors for the development of mental health problems. Social and family support, along with a positive coping style, was associated with better outcomes.

Conclusion: The impact of the COVID-19 pandemic on mental health of children and adolescents is multifaceted and substantial. Survey studies regarding child and adolescent mental health amid COVID-19 indicated that anxiety, depression, loneliness, stress, and tension are the most observed symptoms. Positive coping strategies with family and social support may be important to achieving better outcomes. Due to limited available evidence, more well-designed studies in this area are urgently needed.

Keywords

Child, adolescent, COVID-19, mental health, survey, review

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Introduction

The 2019 novel coronavirus disease (COVID-19) outbreak has profoundly impacted the daily lives of most of the global population. With daily epidemiological updates, the outbreak has consistently received a great deal of attention from the media worldwide. The pandemic has unavoidably produced an enormous amount of mental health stress for individuals and families around the world.

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Although most children and *adolescents* infected with COVID-19 appear to have had mild to moderate symptoms, and limited mortality rates,¹ a recent review has identified various mental health problems among those exposed to the COVID-19 pandemic, including anxiety, stress, depression, panic, irritation, impulsivity, *somatization*, sleep problems, *emotional lability*, post-traumatic *stress disorder* (PTSD), and suicidal behavior.² Necessary actions of transmission reducing (e.g. quarantine and social distancing) may enhance physical safety of children and adolescents but at the same time come with increased risks of psychological impacts in this vulnerable age group. Rising numbers of confirmed cases and deaths, fear of infection, lack of education access due to school closures, disruption of daily routines due to home confinement, and social distancing, as well as family financial loss have all contributed toward increased feelings of anxiety, stress, and uncertainty among children and adolescents.^{3,4}

A narrative review was performed on the knowledge of the pandemic and child and adolescent psychiatry practice experience, indicating that child and adolescent psychiatric care during all phases of the pandemic is an unmet urgent need for long-term mental health impacts of children and adolescents.⁵ Imran et al.³ conducted an overview of distress in different age groups of children and adolescents in 2020, and provided relevant interventions and resources for child mental health and wellbeing promoting during this pandemic outbreak. The lockdown measures (in response to the COVID-19 pandemic) resulted in psychological distress in children and adolescents, especially in those vulnerable groups suffering from mental health issues.⁶ As a result, various psychological interventions were needed to address the pandemic-related mental health disorders of school returning children under 12 years old. Cognitive behavior therapies and school-based interventions were the most common interventions.⁷

Concerns regarding the impact of the pandemic on children and adolescents are rapidly growing. Ideally, this impact would be investigated via direct in-person studies. However, given the physical distancing requirements, in-person studies have not been feasible. Rather, survey studies have recently been utilized as an important tool for assessing and understanding the mental health impact of children and adolescents during the pandemic. However, there are no existing systematic reviews comprehensively summarizing existing available surveys on the impact of COVID-19 on the mental health of children and adolescents. In this context, this systematic review tried to synthesize currently existing survey studies regarding the mental health impact of children and adolescents' mental health problems related to COVID-19, with the aim (1) to provide Healthcare Providers and Public Health officials with an up-to-date overview in regard to the current literature about child and adolescent mental health during the COVID-19 pandemic and (2) to provide researchers with an outline of the current studies leading to identification of the need for the design of future studies.

Methods

Data source and search strategy

A comprehensive electronic search through multiple databases from December 2019 to December 2020, limited to the English language, was conducted. The databases included Ovid Embase, Ovid Cochrane Database of Systematic Reviews, Ovid Cochrane Central Register of Controlled Trials, Ovid MEDLINE(R) and Epub Ahead of Print, In-Process and Other Non-Indexed Citations and Daily, Web of Science, PsycInfo, Scopus databases, and Google Scholar. The search strategy was conceived, developed, and executed by a Mayo Clinic, Rochester campus librarian with input from the study's principal investigator. Both controlled vocabularies and keywords describing child and adolescent mental health problems related to COVID-19 pandemic were used to search. The actual strategy listing all search terms used and how they are combined is available in the Appendix.

Inclusion and exclusion criteria

Any survey study regarding information about child and adolescent mental health amid COVID-19 was included in this review. In accordance with age definitions put forth by the World Health Organization (WHO)⁸ and United Nations, we included participants aged from 0 to 19 years (children and adolescents).⁹ All types of survey data including questionnaires and interviews, and different countries of origin were eligible for inclusion. There was no limitation in intervention, comparison, or outcome evaluation. Articles that exclusively reported data on participants above 19 years old, not related to epidemiological and clinical aspects of interest, or not written in the English language were excluded.

Study selection and data extraction

Two independent authors screened titles and abstracts of all publications and excluded all irrelevant articles. Eligibility criteria were applied to the full-text articles through the selecting studies. Pre-defined information of each study, including the first author, country, publication date, population, design, intervention, mental health type, and result, was extracted into a password-protected Microsoft Excel spreadsheet. Selection and extraction were completed by two authors independently. Any disagreement regarding eligibility was addressed through a discussion with a third author.

Methodological quality assessment

Studies selected for retrieval were evaluated by two authors independently for methodological quality before they were included in the review using the Critical Appraisal Skills Programme (CASP)¹⁰ Qualitative Checklist for qualitative studies (<https://casp-uk.net/casp-tools-checklists/>). Quality

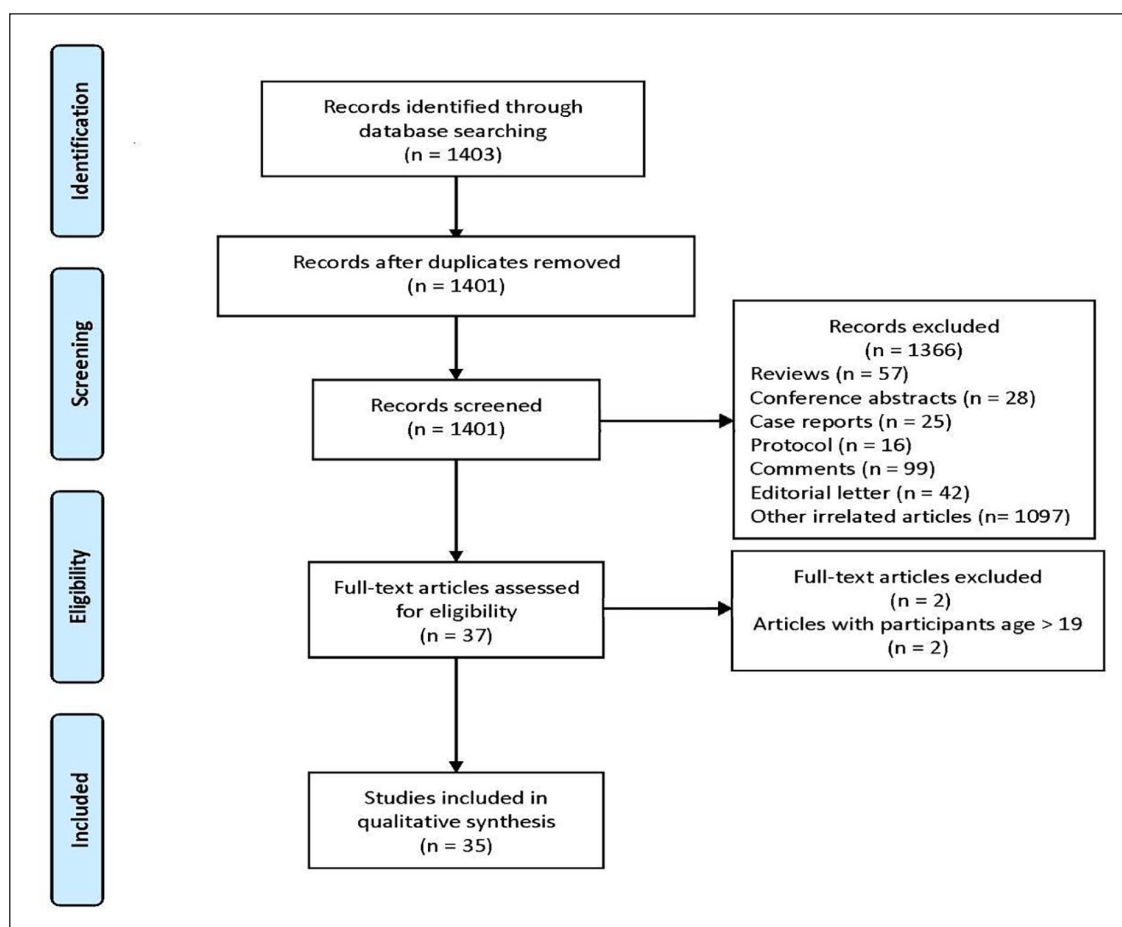


Figure 1. PRISMA flowchart for literature search.

of each study was assessed with 10 criteria. Studies were rated as “low quality,” “medium quality,” and “high quality.” Two authors assessed the quality independently, with any discrepancy between them being resolved by consultation with the third author.

Data synthesis

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist was used to guide the reporting of this review.^{9,11} Due to the heterogenous nature of the data from the preliminary studies, a descriptive summary with Microsoft Excel tables was produced to summarize the literature.

Results

Study selection

A total of 1403 potentially eligible titles and/or abstracts were identified by the search strategy. Among them, 2 records were excluded because they were identified as duplicate

records, and other 1366 irrelevant records were removed after screening the abstracts and title. After removing the duplicates and irrelevant articles, 37 full-text publications were further screened. Thirty-five survey studies met the pre-defined inclusion criteria. Details of the screening process are summarized in Figure 1. Due to the variations in themes, mental health impacts, methods, and outcome measurements between studies, a meta-analysis was not conducted; rather, a narrative synthesis of the data was performed.

Study characteristics

The study characteristics of the 35 included articles are summarized in Tables 1 and 2. The total number of participants included was 65,508, with age ranging from 4 to 19 years old. Twenty-seven of the included studies were surveys, while the other eight involved interviews. In terms of the outcome measurements employed in these studies, 71% (25/35) studies^{12–36} used validated psychometric tools that have been previously standardized and/or established for their psychometric properties, and 29% (10/35)^{37–46} used questionnaires developed for their respective studies.

Table 1. Characteristics of Included trials.

Author	Year	Country	Design	Ethic approval	Informed consent	N	Population	Age	Mental health condition(s) assessed	Respondent rate	Quality assessment
Abawi ¹²	2020	Netherlands	Cross-sectional interview	Yes	Yes	90	Children and adolescents with severe obesity	4-18	Anxiety	83%	Medium
Garcia de Avila ²⁰	2020	Brazil	Cross-sectional online interview	Yes	No	289	Children	6-11	Anxiety	100%	High
Cauberghel ¹⁶	2020	Belgium	Cross-sectional online survey	Yes	Yes	2165	Adolescents	13-19	Anxiety, depression, and loneliness	100%	High
Chen ¹⁷	2020	China	Cross-sectional survey	Yes	Yes	7866	Wuhan, Beijing, and Hangzhou adolescent	13-19	Anxiety and depression	99%	High
Dong ¹⁸	2020	China	Cross-sectional online survey	Yes	Yes	2270	School-age children and adolescents	6-18	Anxiety, depression, schizophrenia, bipolar disorders, obsessive-compulsive disorder, and substance use disorders	90%	High
Duan ¹⁹	2020	China	Cross-sectional online survey	No	Yes	3613	Children and adolescents	7-18	Anxiety and depression	88%	High
Kang ²²	2020	China	Cross-sectional online survey	Yes	Yes	5500	Chinese Adolescents	15-18	Depression, tension, anger, fatigue, and confusion	89%	High
Kilincel ²³	2020	Turkey	Cross-sectional online survey	Yes	Yes	745	Adolescent	12-18	Anxiety and loneliness	100%	High
Metwally ²⁶	2020	Egypt	Cross-sectional online survey	Yes	Yes	2015	Egyptian primary schoolchildren	8-12	Common phobias	100%	High
Qi ²⁹	2020	China	Cross-sectional online survey	Yes	Yes	7,383	Chinese Adolescents	14-18	Anxiety and depression	98%	High
Zhang C ³³	2020	China	Cross-sectional online survey	Yes	Yes	564	Teenagers	12-19	Anxiety, depression, stress, and PTSD	87%	High
Zhang X ³⁵	2020	China	Cross-sectional online survey	Yes	Yes	9979	Children and Adolescents	10-13	tension, depression, anger, fatigue, and confusion	100%	High
Zhou ³⁶	2020	China	Cross-sectional online survey	Yes	Yes	8140	Chinese adolescents	12-18	Depressive and anxiety	99%	High
Ademhan Tural ¹³	2020	Turkey	Cross-sectional online survey	Yes	Yes	285	Children with chronic lung disease	4-18	Anxiety and depression	78%	High
Wiguna ⁴⁵	2020	Indonesia	Cross-sectional online survey	Yes	Yes	213	Adolescent	11-17	Anxiety	53%	High
Oosterhoff ²⁷	2020	USA	Cross-sectional online survey	Yes	Yes	683	Adolescents	13-18	Anxiety, depression, belongingness, burdensomeness	98%	High
zhang J ³⁴	2020	China	Cross-sectional online survey	Yes	No	241	School-age children with ADHD	6-15	Acute stress	100%	High
Jiao ²¹	2020	China	Cross-sectional online survey	Yes	Yes	320	Children and adolescents	3-18	Anxiety, depression, clinginess, distraction, irritability, and fear	100%	Medium

(Continued)

Table 1. (Continued)

Author	Year	Country	Design	Ethic approval	Informed consent	N	Population	Age	Mental health condition(s) assessed	Respondent rate	Quality assessment
Seğer ³⁰	2020	Turkey	Cross-sectional online survey	Yes	Yes	598	Youth	14-18	Anxiety, depression, and OCD	98%	High
Bignardi ¹⁵	2020	UK	Longitudinal online survey	Yes	Yes	659	Childhood	7-12	Anxiety and depression	25%	High
Magson ⁴⁰	2020	Australia	Longitudinal online survey	Yes	Yes	467	Adolescent	13-16	Anxiety and depression	53%	High
Rogers ⁴²	2020	USA	Longitudinal online survey	Yes	Yes	609	Adolescents	13-17	Anxiety, depression, and loneliness	67%	High
Alves ¹⁴	2020	USA	Longitudinal phone or video call interview	Yes	Yes	162	US Children	9-15	Anxiety and stress	51%	High
Abdulah ³⁷	2020	Iraqi	Arts-based methods Interview	Yes	Yes	15	Children	4-18	Anxiety, depression, loneliness, tiredness, insomnia, and worry	100%	High
Asanov ³⁸	2020	Germany	Telephonic interview	Yes	No	2412	Ecuadorian high-school students	14-18	Depression	62%	High
Pinar Senkalfa ²⁸	2020	Turkey	Telephonic interview	Yes	No	135	Children with cystic fibrosis	13-18	Anxiety and depression	67%	High
Schwartz-Lifshitz ⁴⁴	2020	Israel	Telephonic interview	Yes	Yes	50	Children and adolescents with obsessive compulsive disorder	8-19	Obsessive compulsive symptoms	58%	High
Saurabh ⁴³	2020	India	Longitudinal in-person interview	Yes	Yes	252	Children and Adolescents	9-18	Worry, helplessness, fear, nervousness, annoyance, anxiety, isolation, boredom, and sadness	100%	High
Masuyama ²⁵	2020	Japan	In-person survey	Yes	Yes	629	Adolescents	12-14	Anxiety and fear	100%	High
Ellis ³⁹	2020	Canada	Longitudinal online survey	Yes	Yes	1316	Adolescent high school students	14-18	Anxiety, depression, loneliness, and stress	80%	High
Luthar ²⁴	2020	USA	Computer-based survey	No	Yes	2546	High school adolescents	14-18	Anxiety, depression, rule-breaking, and substance use	96%	High
Risin ⁴¹	2020	USA	Online survey	No	No	109	Adolescent	12-19	Anxiety and fear	100%	High
Smirni ³¹	2020	Italy	Online survey	Yes	Yes	148	Older Adolescents	7-19	Anxiety	84%	High
Xiao ⁴⁶	2020	China	Online survey	Yes	Yes	1680	Chinese Adolescents	5-17	tension, depression, anger, fatigue, confusion, and vigor	70%	High
Yue ³²	2020	China	Online survey	Yes	Yes	1360	Children	8-13	Anxiety, depression, and PTSD	100%	High

ADHD: attention deficit hyperactivity disorder; PTSD: post-traumatic stress disorder; OCD: obsessive-compulsive disorder.

Table 2. Aims, Measurements, and Conclusions of Included Studies.

Author	Study aim	Measurements	Conclusions
Abawi ¹²	To explore COVID-19 related anxiety in children with severe obesity and their parents.	Pediatrics Quality of Life Inventory questionnaire, Self-imposed strict quarantine measures	Healthcare professionals addressing COVID-19 related anxiety among children with severe obesity could mitigate its potential negative effects.
Garcia de Avila ²⁰	To assess the prevalence and associated factors of anxiety among Brazilian schoolchildren during COVID-19.	Children's Anxiety Questionnaire; Numerical Rating Scale	Public health actions are necessary for the anxiety of children and their parents.
Cauberghel ¹⁶	To examine the benefit of social media for adolescents to cope their anxiety and loneliness during the quarantine.	The Center of Epidemiological Studies-Depression Scale, the General Anxiety Disorder Scale (GAP-7), The Brief-Coping Scale	Social media can be useful for adolescents to deal with their anxiety during the COVID-19 quarantine.
Chen ¹⁷	To explore the clinically significant differences in anxiety, depression, and their contributing factors comparing adolescents from Wuhan and other cities in China.	The Short Egna Minnen Beträffande Uppfostran, the Patient Health Questionnaire, Generalized Anxiety Disorder-7	Several risk factors for adolescents' depression and anxiety during the pandemic.
Dong ¹⁸	To assess the use of internet and potential psychological factors associated with Internet addiction during the pandemic.	The Chinese version of Young's Internet Addiction Test, the mental state was assessed using the Chinese version of Depression, Anxiety, and Stress Scale	Observed excessive Internet use was found among Chinese children and adolescents during the pandemic. Age, gender, depression, and stress were the potential key factors.
Duan ¹⁹	To demonstrate the psychological effects on children and adolescents associated with the epidemic.	The Chinese Version of Spence Child Anxiety Scale, the Child Depression Inventory, the Short Version of Smartphone Addiction Scale, the Internet Addiction Scale, the Coping Style Scale	COVID-19 outbreak had a significant psychosocial impact on children and adolescents.
Kang ²²	To explore the relationship of physical Activity and sedentary time with mood states among Chinese adolescents during the pandemic.	The International Physical Activity Questionnaire Short Form - Chinese version, the simplified Chinese Profile of Mood States	Chinese adolescents maintained a sedentary lifestyle and more physical activity was associated with improving mood state among adolescents in the pandemic.
Kilincel ²³	To determine the results of home-quarantine measures taken for adolescents during the pandemic and the affecting factors.	State-Trait Anxiety Inventory Trait Anxiety Scale	School closure and home-quarantine measures caused anxiety and loneliness in young people. Various social connections are helpful for them.
Metwally ²⁶	To identify the prevalence of most common phobias as well as panic disorder due to COVID-19 among Egyptian primary schoolchildren and their determinants.	Diagnostic and Statistical Manual of Mental Disorders, self-report rating scale,	The prevalence of panic disorder during the pandemic is high. Calming down could be recommended for children experienced with a phobia.
Qi ²⁹	To explore the association between the levels of social support and mental health among Chinese adolescents during the outbreak.	Patient Health Questionnaire-9, Chinese version of the 7-item Generalized Anxiety Disorder scale, Social Support Rate Scale	Higher prevalence of mental health problems among adolescents with medium and low levels of social support in China during COVID-19.

(Continued)

Table 2. (Continued)

Author	Study aim	Measurements	Conclusions
Zhang C ³³	To assess psychological consequences of the pandemic among junior high and high school students in China.	Brief Resilience Scale, Coping Style Questionnaire, Impact of Event Scale-Revised, Twenty-one-item Depression Anxiety Stress Scale.	More than 20% junior high and high school students' mental health was affected during the pandemic. Resilience and positive coping are beneficial for their mental health status.
Zhang X ³⁵	To examine the impacts of social isolation on physical activity levels and mood states of children and adolescents and determinants during the epidemic.	The International Physical Activity Questionnaire Short Form, the Profile of Mood States	Higher levels of physical activity were associated with better mood states in children and adolescents.
Zhou (A) ³⁶	To assess the prevalence of anxiety and depression, and their socio-demographic correlates among Chinese adolescents in the COVID-19 outbreak.	Patient Health Questionnaire-9, the Generalized Anxiety Disorder-7	High prevalence of psychological health problems among adolescents are negatively associated with the level of awareness of COVID-19.
Ademhan Tural ¹³	To assess the anxiety and depression related to COVID-19 in children with chronic lung disease and their parents and to evaluate parents' coping strategies.	The General Health Questionnaire-12, The Coping Orientation to Problems Experienced inventory, The coronavirus-related psychiatric symptom scale in children-parental form, other specific questions	Children with chronic lung diseases and their parents have more anxiety due to COVID-19. Parents used more mature coping strategies to manage the stress of the pandemic.
Wiguna ⁴⁵	To preliminary identify proportion of adolescents' emotional and behavior problems and several factors related to it during COVID-19 pandemic in Indonesia.	Self-developed questionnaire, Strength and Difficulties Questionnaire	Adolescents in Indonesia were at high risk for emotional and behavior problems due to school closures in the COVID-19 pandemic.
Oosterhoff ²⁷	To examine connections between social distancing engagement, social distancing motivations, and adolescents' mental health and social health.	Self-developed assessment of social distancing, the short fixed-form 8-item Patient-Reported Outcomes Measurement Information System anxiety scale, the short-fixed form 8-item Patient-Reported Outcomes Measurement Information System depression scale, the Interpersonal Needs Questionnaire, the Interpersonal Needs Questionnaire	Understanding adolescents' motivations to engage in social distancing may improve social health
Zhang J ³⁴	To investigate the mental health related conditions of children with ADHD during the COVID-19 outbreak.	Swanson, Nolan, and Pelham scale – parent form, the Child Stress Disorders Checklist, Time allocation of children's activities, Mood state of the children and parents, Attention to media coverage of the 2019-nCoV outbreak Diagnostic and Statistical Manual of Mental Disorders criteria	Children's ADHD symptoms were significantly worse compared to normal state and attention for appropriate approach identification during this pandemic is required.
Jiao ²¹	To investigate the children's behavioral and emotional responses to the current epidemics.		Clinging, inattention, and irritability were the most severe psychological conditions. Young children (3-6 years) were more likely than older children (6-18 years) to manifest symptoms. Older children were more likely to show inattention and persistent inquiry. Media entertainment was largely successfully used by families over reading and physical exercise for children's negative psychological conditions.

(Continued)

Table 2. (Continued)

Author	Study aim	Measurements	Conclusions
Seçer ³⁰	To examine the mediating role of emotional reactivity, depression-anxiety and experiential avoidance in the relationship between the fear of COVID-19 and obsessive-compulsive disorder symptoms in adolescents.	Emotional Reactivity Scale, Depression and Anxiety Scale for Children, The Fear of COVID-19 Scale, Experiential Avoidance Questionnaire	The effect of COVID-19 fear on obsessive-compulsive disorder is mediated by emotional reactivity, experiential avoidance, and depression-anxiety.
Bignardi ¹⁵	To test whether changes in emotional well-being, anxiety and depression occurred during the national lockdown.	the Strengths and Difficulties Questionnaire, Emotional Problems subscale, Revised Child Anxiety and Depression Scale	Children's depression ratings significantly increased during the lockdown; it was not uniform change across children.
Magson ⁴⁰	To examine the psychological impact of the COVID-19 pandemic among adolescents	The Generalized Anxiety subscale, the Short Mood and Feelings Questionnaire—Child Version, the Student's Life Satisfaction Scale, 8-item measure assessing COVID-19 related distress, Self-developed Scale for Interpersonal conflict, the Social Connectedness Scale	Adolescents were more concerned about the government restrictions for covid-19 management, which were associated with increased anxiety and depressive symptoms, and decreased life satisfaction.
Rogers ⁴²	To assess depth and breadth in adolescents' subjective experiences with COVID-19 and to examine whether these perceptions were associated with their mental health above and beyond their pre-pandemic mental health levels.	Open-ended responses regarding experiences with COVID-19, Perceived relationship changes during COVID-19, Perceived mood changes during COVID-19, Indices of mental health, Demographic controls.	Sensitize clinicians and scholars to the vulnerabilities, as well as resiliencies presented to U.S. adolescents during the early months of COVID-19.
Alves ¹⁴	To investigate the emotional responses, physical activity, and sedentary behaviors related to anxiety among US children during the pandemic.	24-h physical activity recall, State-Trait Anxiety Inventory for Children, the Positive and Negative Affect Schedule for Children, the shortened 10-item Positive and Negative Affect Schedule for Children	Maintaining positive affect, engaging in physical activity, and limiting leisure screen time might be important for child mental health during stressful periods.
Abdulah ³⁷	To explore the psychological wellbeing of children during the COVID-19 outbreak among children in Iraqi Kurdistan.	Self-developed draw his/her feelings, reflections, and responses during the COVID-19 on a paper	Children exhibited a strong feeling of distress, loneliness, and fear during the COVID-19 outbreak.
Asanov ³⁸	To evaluate students' time during the period of quarantine, examine their access to remote learning, and measure their mental health status.	Self-developed scales for remote learning technologies, 24-hour time use questionnaire, The 5-item mental health index	School closure and social isolation were the two main problems for students, while the majority of them are happy, except for 16% were depressive.
Pinar Senkalfa ²⁸	To evaluate anxiety among children with cystic fibrosis and their mothers related to the COVID-19 pandemic.	The State-Trait Anxiety Inventory for Children, the State and Trait Anxiety Inventory	COVID-19 had no effect on the anxiety of children with cystic fibrosis. Informing their parents about COVID-19 by teleconference may decrease anxiety.
Schwartz-Lifshitz ⁴⁴	To evaluate whether Obsessive compulsive symptoms exacerbated during the first wave of COVID-19 in children and adolescents.	Diagnostic and Statistical Manual version 5, Clinical Global Impression- symptom severity and improvement scales, the Obsessive-Compulsive Inventory-child version, Israel Index of Deprivation, Self-developed scale for patients' subjective feeling of functioning	Israeli children and adolescents with obsessive compulsive symptoms coped well with COVID-19 during the first two months of the pandemic.

(Continued)

Table 2. (Continued)

Author	Study aim	Measurements	Conclusions
Saurabh ⁴³	To describes understanding, compliance and psychological impact of quarantine on children and adolescents in the Covid-19 outbreak.	Self-developed questionnaire for knowledge of quarantine facility, compliance during quarantine and psychological effect of quarantine	Adequate financial support and enhanced knowledge can improve compliance and mental health problems.
Masuyama ²⁵	To adapt and validate a Japanese-version Fear of COVID-19 Scale (FCV-19S) with a sample of adolescent students from Japan.	Japanese-version FCV-19S, Generalized Anxiety Disorder 7-item scale, Patient Health Questionnaire for Adolescents, and Perceived Vulnerability to Disease Scale	The Japanese-version FCV-19S has a high internal consistency and a moderately good construct validity.
Ellis ³⁹	To examine the relationships between psychological adjustment and reported stress associated with the initial COVID-19 crisis.	Self-developed scales for COVID-19 stress, Social media use and Time in daily activities, the Brief Symptom Inventory (BSI), the revised UCLA Loneliness Scale	Adolescents were very concerned about the COVID-19 crisis and are particularly worried about schooling and peer relationships.
Luthar ²⁴	To examine the reliability and validity of the Well-Being Index as a useful potential measure of well-being of students in school-wide assessments.	Well-Being Index, Schools' Assessments of Students' Mental Health Extant Measures of Youth Mental Health	Well-Being Index Is a brief, psychometrically sound measure to assess the adjustment of adolescents.
Risin ⁴¹	To use statistical analysis to analyze the relationships between emotions and actual understanding of COVID-19.	7 multiple choice questions on a range of topics related to the virus such as spread, key terminology, and cause of death, self-developed questions for anxiety, fear as well as background	Knowledge of covid-19 is linked to lower anxiety and fear levels.
Smirni ³¹	To investigate the state of anxiety and emotional awareness in a sample of healthy older adolescents.	The Zung Self-Rating Anxiety Scale (SAS), the self-reported Italian Emotion Awareness Questionnaire (EAQ),	COVID-19 pandemic may be a risk condition for an increased state of anxiety in older adolescents.
Xiao ⁴⁶	To understand Chinese adolescents' mood and physical activity during lockdown.	The Chinese version of the Profile of Mood States short form, the Leisure-Time Exercise Questions, Self-reports for Screen Time, Conflicts with Parents and Demographic Factors	Promoting physical activity and decreasing screen time among adolescents during school closure is an effective way to minimize negative mood and conflicts with parents.
Yue ³²	To examine the psychological status of Chinese families during the COVID-19 outbreak and determinants.	The Chinese version of Zung Self-rating Anxiety Scale, Chinese version of Center for Epidemiologic Studies Depression Scale for Children, the Chinese version of Zung Self-rating Depression Scale the revised Chinese version of PTSD Checklist for DSM-5, A 5-point Likert scale	Children and their parent in non-severe area didn't suffer major psychological distress due to psychological interventions during the pandemic.

UCLA: University of California, Los Angeles.

The CASP summary of the quality appraisal of each study was presented in Table 1. From the 35 papers, 1 study²¹ was rated as “medium quality” and the other 34,^{12–20,22–46} as “high quality.” All the 35 studies had clear aims, appropriate methodology, research design, recruitment strategy, data collection, and clear study finding statement with high reliability and validity. No study meets the criteria for the consideration of the researcher–participant relationship. Three studies did not provide ethical approval.^{19,24,41} Rigorous data analysis was clearly presented in all but two studies.^{21,37} The research value was adequately discussed in most studies. Moreover, all studies received a positive research value except one study²¹ that did not clearly meet the criteria due to insufficient survey details. As expected, due to quarantine restrictions and distancing requirements, most survey data were collected online (72.7%),^{13,15–20,22,23,26,27,29,31–36,39–42,45,46} or via telephone (15.2%).^{12,14,28,38,44} The remaining were gathered person to person (12.1%).^{24,25,37,43} The response rate varied from 25% to 100%.

There was great geographical diversity of publications, with 12 publications derived from China, 5 from the United States, 4 from Turkey, and 1 from Australia, Belgium, Brazil, Canada, Egypt, Germany, India, Indonesia, Iraqi, Israel, Italy, Japan, the Netherlands, and the United Kingdom, respectively. Approximately 91% of included surveys stated ethical approval and 84.5% of them reported that written informed consent had been obtained.

After reviewing available data in the literature, four main themes were addressed across the included articles: (1) mental health effects of COVID-19 on children and adolescents; (2) mental health impacts of COVID-19 on vulnerable children and adolescents; (3) risk factors for adolescents' mental health during the COVID-19 pandemic; and (4) therapeutic interventions and strategies. Details of clinical characteristics are summarized in Table 1 and 2.

Impact of COVID-19 on child and adolescent mental health

The outbreak of COVID-19 has had a multifaceted and substantial impact on child and adolescent mental health, with the most frequently reported psychological reactions being anxiety (28%), depression (23%), loneliness (5%), stress (5%), fear (5%), tension (3%), anger (3%), fatigue (3%), confusion (3%), and worry (3%). Mental health symptoms were assessed using various validated measures as outlined in the summary of included studies. In terms of the outcome measurements employed in these studies, 71% (25/35) studies^{12–36} used validated psychometric tools that have been previously standardized and/or established for their psychometric properties, and 29% (10/35)^{37–46} used questionnaires developed for their respective studies.

Focus on vulnerable children and adolescents

The effects of the COVID-19 pandemic are problematic and potentially enduring on the mental health of children and adolescents, particularly in those with underlying psychiatric and/or developmental disorders.⁴ Anxiety, absence of peer contact, lack of stress regulation, domestic violence, and child maltreatment threats are significant concerns for the mental health of this population.⁵ In our review, five publications addressed populations who might be more vulnerable than others to mental health disorders amid the pandemic, including children and adolescents with severe obesity,¹² chronic lung disease,¹³ attention deficit hyperactivity disorder,³⁴ cystic fibrosis,²⁸ and obsessive-compulsive disorder.⁴⁴ Study results illustrated the significant need to focus on these vulnerable groups. Healthcare support for these vulnerable children and adolescents and their parents during this pandemic could help mitigate the potential negative effects.

Risk factors associated with adverse adolescents' mental health

Our review identified four broad categories of risk factors that might be associated with poor adolescent mental health functioning during the pandemic. Female gender and higher grade levels are two risk factors. Both factors were also found to be associated with higher risk for depression and anxiety during the pandemic.³⁶ Next, young adolescents who prefer outdoor social activities might be at higher risk for experiencing anxiety or depressive symptoms during the COVID-19 pandemic.²⁷ Furthermore, psychological qualities such as emotional reactivity and experiential avoidance among adolescents might increase the risk of developing psychosocial disorders, a finding which was supported by a survey among 598 Turkish adolescents.³⁰ Finally, the utilization of negative coping strategies, including behavioral avoidance, denial, and substance use, is a risk factor for depression, anxiety, and stress symptoms in high school students.³³

Therapeutic interventions and strategies

No proven effectiveness studies were identified in our literature search. However, several of the included studies did recommend possible interventions according to risk factors, psychologic needs, coping strategies, personal experience, and social responses. These interventions include the following:

Positive coping strategies among children and adolescents. COVID-19 poses large-scale and substantial stress on the mental health of children and adolescents. Literature evidence indicates that positive coping strategies are closely related to mental health outcomes during the COVID-19 pandemic. Positive coping strategies include actively reducing stress, developing accurate knowledge about the pandemic,⁴¹ connecting with friends and family members,³⁹

engaging in physical activities,^{14,22,35} limiting leisure screen time,¹⁴ and cognitive restructuring.³³ These strategies are associated with better mental health outcomes during the pandemic.

Family support. COVID-19 results in a restructuring of the daily life of each family member. Both children and adult family members must handle the stress of social distancing, staying at home, schooling from home, and working from home. Negative mood, such as anxiety, depression, and stress due to the long-term lockdown, may increase family tension and the likelihood of conflict between children and other family members.^{13,18,21,28,34,39} It is important to deal with the psychological changes from a family perspective during the pandemic, especially for high-risk populations.

Social response and preparedness. Additional social support, including schools, social media, healthcare, and government support, is urgently needed during the pandemic.²⁹ When properly supported, children and adolescents (especially those with disabilities) and their families and schools can appropriately face the most immediate and potentially harmful mental health changes associated with the pandemic.^{12,18,23,42} Education support has been reported as an important intervention for children and adolescents' mental health during the pandemic. Schools are established as supportive environments for adolescents staying connected with their peers and teachers during the pandemic.⁴⁵ Teachers are encouraged to assist children in finding ways to maintain their social networks.⁴⁰ During the pandemic, information changes rapidly, and television and social media largely consist of news about the disease. Social media are among the most widely used sources, which can be used as a constructive coping strategy for adolescents to manage negative emotions evoked by the COVID-19 crisis.¹⁶ Furthermore, the local, state, and federal governments need to pay more attention to the psychological health of children and adolescents during the pandemic. A higher prevalence of mental health problems impacts children with lower level knowledge and social support during the pandemic.^{29,36} Adolescents who adhered more closely to the government restrictions of stay-at-home orders and who felt more socially connected during the pandemic lockdown were less likely to experience anxiety, depression, or decreased life satisfaction.⁴⁰ Quarantine-related financial loss was found to be a risk factor for developing psychological symptoms. Children were significantly concerned about family-related financial loss, parental employment status, future uncertainties, and resource vulnerabilities (daily needs like food, water, housing, Internet) during the quarantine period. Adequate financial support and enhanced knowledge about pandemic planning can improve their mental health.^{29,43}

Discussion

This review suggests that the outbreak of COVID-19 has had a multifaceted and substantial impact on child and adolescent

mental health. The included survey studies specifically examined the potential mental health impacts of social distancing, school closure, and quarantine on children and adolescents. Many of the included studies provide numerous valuable observations and suggestions on feasible preventive strategies to limit the pandemic-related mental health consequences. Suggested strategies to help ameliorate an increase in mental health problems include expanding government economic support, clinical preventive support, and early intervention preparedness.

Given the initial uncertainties about disease transmission, survey-based studies have been particularly useful for assessing the mental health of children and adolescents during the pandemic. We identified 35 surveys, 90% of which were delivered online or by phone, thus averting any concerns related to face-to-face visits. Several of the surveys suggested that most of the participants were comfortable with the non-face-to-face survey methodology. Similarly, non-face-to-face interventions (e.g. tele-psychotherapy and online solutions) were the most common interventions employed to address the unique needs of the COVID-19 public health crisis.

Children and adolescents who were isolated or quarantined during the pandemic were more vulnerable to develop acute stress disorder, adjustment disorder, or grief.⁴⁷ Further, lacking social communication was a risk factor associated with adolescents being drawn into compulsive Internet use during the COVID-19 pandemic. This point was highlighted in a large cross-sectional anonymous survey, conducted among Chinese children and adolescents aged 6–18 years, where 2.68% of participants self-identified as excessive Internet users and 33.37% as problematic Internet users. Age, female gender, stress, and depression were significantly associated with Internet addiction.¹⁸ Our findings also support previous conclusions and suggest that family and social support are required to provide more acceptable ways of supporting mental health for children and adolescents.

There is preliminary evidence to support the acceptability of synthesizing survey research for current knowledge about child and adolescent mental health associated with the COVID-19 pandemic. Following the CASP checklist tool for qualitative research, study quality was rated generally as moderate to high, increasing the reliability within the inputs to this synthesis. The findings of this review represent a sound and comprehensive methodological synthesis of current surveys regarding children and adolescents' mental health issues related to the COVID-19 pandemic that can be incorporated within current optimal clinic practice and research.

Strengths and limitations

We believe this is the first systematic review comprehensively summarizing all existing survey studies addressing children and adolescents' mental health issues associated with COVID-19. Strength and challenges of the COVID-19

mental health research response has been reviewed recently by Demkowicz et al.,⁴⁸ especially raising the question whether speed may compromise quality. In our opinion, this review is objective, well structured, and rigorously followed pre-defined criteria.

However, the current review does have some limitations. First, we conducted an electronic database search for literature published in the English language only, thus possibly omitting some eligible articles published in other languages. Second, with the lack of randomized controlled trial evidence, our review indicates that the available data are not robust enough to identify any single optimal treatment to address the negative effects that COVID-19 has on the mental health of children and adolescents. Third, there are currently 216 countries, areas, or territories with confirmed cases of COVID-19, while our included articles originated from only 11 affected countries. There is an urgent need for more representative studies, particularly in areas most impacted by the COVID-19 crisis. Finally, in the included surveys, most children were healthy, non-referred individuals. Thus, the generalizability to lesser studied groups, like those with pre-existing mental health problems or development issues, is limited. It is also important to note that although children expressed positive attitudes toward electronic healthcare, it does not necessarily mean that electronic healthcare is superior to face-to-face interventions.

Conclusion

Multiple survey studies indicate that mental health issues among children and adolescents are closely related to the COVID-19 pandemic, as well as to various mitigating strategies (social distancing, quarantine, and school closure). Anxiety, depression, stress, loneliness, and tension are the most reported changes. Positive coping strategies along with family and social support in this context are urgently needed as clinical practice guidelines and additional research. However, the available supporting evidence is limited, and more well-designed studies are needed.

Author contributions

BAB and JY had the idea for the study and designed the study. MT, DB, and WC searched, screened, and extracted the data. JY analyzed the data. MS and JY wrote the first draft of the article. MS, TYC, ABM, DB, and DLW-R reviewed and edited the article. All authors approved the final article.

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Supplemental material

Supplemental material for this article is available online.

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