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Review article

COVID-19 and mental health disorders in children and adolescents (Review)

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ABSTRACT

The new coronavirus has been present for two years and has had a widespread and sustained impact worldwide. There is growing evidence in the literature that COVID-19 may have negative effects on mental illness in patients and in healthy populations. The unprecedented changes brought about by COVID-19, such as social isolation, school closures, and family stress, negatively affect people's mental health, especially that of children and adolescents. The purpose of this paper is to review the literature and summarize the impact of COVID-19 disorders on children's and adolescents' mental health, the mechanisms and risk factors, screening tools, and intervention and prevention. We hope that the mental dysfunction caused by the pandemic will be mitigated through appropriate and timely prevention and intervention.

1. Introduction

According to the World Health Organization (WHO), as of March 2022, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes coronavirus 2019 (COVID-19) has infected more than 481 million people worldwide, and nearly 6 million of them have died (WHO, 2022). In addition to the respiratory system, COVID-19 can also affect other organs and systems, such as the digestive and nervous systems (Dong et al., 2020). With the increase in related studies, we have a growing understanding of the sequelae of SARS CoV-2 infection. Some patients with acute respiratory symptoms followed by persistent symptoms such as dyspnea and loss of taste, which are referred to as "Long COVID" or diagnosed as "Long Haul COVID" (Nath, 2020; Lopez-Leon et al., 2021). In adults, long COVID induces muscle weakness, fatigue, shortness of breath, sleeping difficulties, anxiety, and depression.

Compared with adults, children with COVID-19 usually present with one or more respiratory symptoms, and the course of their illness is mostly mild or moderate (Dong et al., 2020). Fewer studies have been reported on symptoms associated with the recovery after infection in children. It was recently observed that 42.6% of children develop sequelae two months after COVID-19 infection, although only 4.7% of them were hospitalized (Buonsenso et al., 2021). Most children infected with COVID-19 are more susceptible to psychological damage than adults, although they have only mild symptoms (Liu et al., 2021). This suggests that children are more vulnerable to mental health problems

than adults when they face the same challenges that as adults, for instance, prolonged isolation, lack of supplies such as food, water, masks, and information about pandemic severity and viral virulence (Loades et al., 2020; Brooks et al., 2020). Currently, the majority of investigations examining the psychological impact of pandemics on children have been conducted in children who are not infected with COVID-19, and a few studies have evaluated infected patients. Mental disorders related to COVID-19 infection in children may therefore be an area of concern, even those with mild symptoms. Consequently, this review summarizes the impact of COVID-19 on the mental health of both pediatric patients and healthy children and adolescents.

2. Mental health disorders in children

2.1. Anxiety

Anxiety is a common mental disorder that begins in childhood and adolescence and affects approximately 6.5% of children (Polanczyk et al., 2015). Anxiety has a direct negative impact on individuals later in life (Essau et al., 2014). Childhood anxiety impairs socio-occupational functioning and may thus negatively affect academic achievement and future accomplishments (Grover et al., 2007). If untreated, anxiety disorders may lead to numerous sequelae and their complications (Bittner et al., 2007). During the COVID-19 pandemic, the epidemic situation becomes increasingly complex and children face dramatic

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changes in their social and living environments: strict governmental measures against the epidemic, e.g., social distancing, school closures, and home isolation; lack of basic necessities and public health supplies; and disinformation and false reports about COVID-19, all of these may aggravate children's anxiety symptoms, increase the incidence of anxiety, and further increase the social costs to families (Duan et al., 2020; Bodden et al., 2008). A descriptive and cross-sectional study of 292 children with COVID-19 showed that 50% of adolescents aged 15-18 years had high levels of anxiety (Solmaz et al., 2022). A follow-up study from China of children recovering from COVID-19 observed a high prevalence of psychiatric disorders, and found that 31.6% of participants had significant anxiety symptoms (Liu et al., 2021). The rate of anxiety in the study cohort was almost twice that of the controls (31.6% vs. 18.9%) (Liu et al., 2021; Xie et al., 2020).

In addition, many studies have investigated the psychological status of children in the overall population during the pandemic, and have found higher levels of anxiety in children compared with the pre-pandemic period (Racine et al., 2021; Ravens-Sieberer et al., 2021). A meta-analysis summarized the results of 29 studies including 80 879 adolescents worldwide, the pooled prevalence and the pooled prevalence of anxiety disorders in children and adolescents was estimated as 20.5% clinically. The prevalence of anxiety symptoms doubled during COVID-19 compared with the pre-pandemic period (Racine et al., 2021). Two longitudinal surveys in Germany found that up to 30.1% of 11- to 17-year-olds had symptoms of generalized anxiety compared with 14.9% before the pandemic (Ravens-Sieberer et al., 2021).

2.2. Depression

Depression results in symptoms of sadness, fatigue, feelings of guilt, disturbed sleep, reduced appetite, concentration, and a lack of interest and pleasure (Śniadach et al., 2021). More importantly depression significantly reduces an individual's functioning and quality of life and is often associated with thoughts of suicide or self-harm. There is increasing evidence that the COVID-19 pandemic has negatively affected the mental health of children and adolescents (Caffo et al., 2020; Orgilés et al. 2020; Śniadach et al., 2021), with a significant increase in the symptoms of depression (Zhou et al., 2020). Specifically, a Chinese survey found that as many as 22.6% of children isolated at home during the COVID-19 pandemic had symptoms of depression (Xie et al., 2020). Few studies have been published on the incidence of depression in children and adolescents infected with COVID-19 (Śniadach et al., 2021). Only one study from Wuhan, China, which investigated mental health problems in 38 children infected with COVID-19, found that 6 (15.8%) children infected with the new coronavirus were categorized as having major depressive symptoms (Liu et al., 2021).

2.3. Post-traumatic stress disorder

Post-traumatic stress disorder (PTSD) appears after experiencing, witnessing, or otherwise confronting any event that involves actual or threatened physical harm to oneself or others, including threatened or actual death, severe injury, or sexual violence. The symptoms include arousal, avoidance, and intrusive thoughts and feelings (Galatzer-Levy and Bryant, 2013). PTSD mainly includes the repetition of traumatic experiences, the continuous avoidance of stimuli related to traumatic events, negative cognitive and emotional changes, and the improvement of alertness. PTSD severely affects psychological and social functioning while negatively impacting quality of life (Chen et al., 2021). Sprang and colleagues found that children who had been quarantined or isolated during the pandemic were more susceptible to acute stress disorders, with 30% meeting the PTSD criteria (Sprang and Silman, 2013). Two studies from Italy and Malaysia reported the presence of PTSD-associated symptoms such as avoidance and intrusive thinking in children and adolescents not infected by COVID-19 during the pandemic (Zainudeen et al., 2021; Davico et al., 2021). Significant increases in

PTSD related to COVID-19 have been reported. Within a month of the start of the pandemic, the prevalence of PTSD among Chinese medical staff was 3.8% (Yin et al., 2020), and the prevalence of PTSD symptoms among Chinese people aged 14-35 years was 12.8% (Liang et al., 2020). A review published by Fong and Iarocci (2020) in November 2020 described how both social and pandemic-related isolation can lead to symptoms of PTSD, fear, and anxiety in children and adolescents (Fong and Iarocci, 2020). However, there is an absence of research on PTSD development experienced after COVID-19 infection in children and adolescents.

2.4. Other mental health-related symptoms

Other behavioral and emotional effects of COVID-19 on children and adolescents have also been reported. For example, stress, precautionary measures, anxiety and depression associated with the COVID-19 pandemic all have the potential to interfere with normal sleep patterns leading to a significant increase in the number of people suffering from insomnia. More than a quarter of COVID-19 survivors (27.0%) were found to suffer from sleep disorders (Groff et al., 2021). Two studies from China showed that during the COVID-19 pandemic, the prevalence of sleep disorders among children and adolescents was 32% and 56%, respectively (Lin et al., 2021; Liu et al., 2021), which was higher than the prevalence of sleep disorders before the pandemic of 21.6% (Xiao et al., 2019). Further analysis suggested that unconstrained sleep schedules, prolonged screen exposure, and limited outdoor activities and peer interaction may contribute to sleep disorders (Liu et al., 2021).

The incidence of mental health symptoms also varied by age during the COVID-19 pandemic (Meade, 2021). Younger children (<7 years) tended to be clingy and fearful, often bored and lacking in cooperation, together with behaviors such as attention-seeking and anxiety (Fitzpatrick et al., 2021; Gassman-Pines et al., 2020; Jiao et al., 2020). In addition to showing higher levels of anxiety and depression, children between the ages of 7 and 13 years tended to misbehave and lack attention, and they required reassurance and experienced academic difficulties (Fitzpatrick et al., 2021; Jiao et al., 2020). The most important behavioral problems for older children or adolescents include anxiety, depression, poor behavior and attention, and impulsivity (Fitzpatrick et al., 2021).

The mental health status of special groups (children with prior mental illness) during the pandemic should be of concern. A survey of children and adolescents with obsessive-compulsive disorder (OCD) showed a tendency toward developing additional symptoms and the worsening of existing symptoms during the COVID-19 pandemic (Tanir et al., 2020). Using an online survey of the mental health of children between 2 and 17 years old ($n = 302$) with neurodevelopmental disorders (NDD), such as ADHD and autism, that was completed by parents and caregivers, Masi et al. (Colizzi et al., 2020) found that over 76% of the respondents reported deteriorations in the overall health of the children, and 64.7% reported a worsening of NDD-associated or comorbid symptoms. Taken together, the pandemic appears to have led to not only deteriorations in existing mental health conditions but also the development of stress-related disorders, especially in children and adolescents whose pre-existing conditions have been exacerbated.

3. Mechanisms or factors

3.1. Factors

3.1.1. For children and adolescents infected with COVID-19

Quarantine. Depending on national epidemic prevention policies, some countries do not treat asymptomatic infected children and require home isolation, while some countries with strict epidemic prevention

measures require asymptomatic infected children to go to specific isolation places for observation (China, 2022). Children with symptoms (0.1–2.0% of children infected with COVID-19) are hospitalized (designated hospitals or mobile cabin hospital) (Harris and Mitch, 2021; China, 2022). Thus, for children and adolescents infected by COVID-19, quarantine is one of the important factors that affects their mental health. COVID-19-infected children and adolescents in quarantine are lonely, they lose their daily social activities, and the socialization process with their peers is interrupted by isolation. Young people, including adolescents, were found to have experienced significant loneliness during the lockdown (Loades et al., 2020; Wang et al., 2017; Orgilés et al., 2020), and loneliness is closely related to the occurrence of mental health problems (Loades et al. 2020). For instance, evidence shows that a sustained experience of loneliness during childhood predicts symptoms of depression reported during adolescence (Qualter et al., 2010). In India, the pandemic has led to a significant increase in psychological distress, including feelings of helplessness (66.11%), anxiety (68.59%), and fear (61.98%), in isolated children compared with nonisolated children (Saurabh and Ranjan, 2020).

Separation from parents. For the majority of uninfected children, they are affected by school closure, reduced social activities, and home isolation, but are not separated from their parents. In contrast, for the few children infected with COVID-19, most are infected because their parents are infected, they may be isolated with their parents. Only when the parents are infected and the child is not, the child is separated from the parents because the parents are isolated (Kılınçel et al., 2021). The separation of children from their parents due to isolation is an important factor that affects children psychologically. Research has concluded that children require the closeness of other people to feel safe, especially during stressful events, and children who are separated from their parents experience increased anxiety, which negatively affects their quality of life (Kılınçel et al., 2021). A cross-sectional study in Qatar found that in 149 COVID-19-infected children, the rate of separation anxiety (57.9%) was significantly higher than the normal prevalence (Khan et al., 2021; Shear et al., 2006). In contrast, staying with parents during a health crisis gives children confidence and reduces their anxiety (Knutsson et al. 2008), as the presence of the parents may assist the children with adapting to their environment (Khan et al., 2021). During the current outbreak, children separated from their parents infected with COVID-19 experienced greater levels of anxiety and negative thoughts, possibly related to the fear of parental departure (Kılınçel et al., 2021). The children's anxiety may thus be the result of both loneliness and the fear of losing a loved one or their own health to the virus.

COVID-19 disease symptoms. Patients with symptomatic COVID-19 are reported to experience higher levels of psychological distress than those who are asymptomatic (Zhang et al., 2020). COVID-19 symptoms are an important factor in the psychological impact of children in the postsocial isolation process. When the patients experienced a greater number of symptoms, their anxiety score may be higher (Solmaz et al., 2022). The lethality of COVID-19 and its extremely high infection rate lead to a fear of injury and death that can induce PTSD (Liang et al., 2020). Children and adolescents lack the ability to adapt and recover from traumatic experiences, which makes them more likely than adults to develop PTSD (Chen et al., 2021).

Age and gender. Some studies have suggested that higher rates of anxiety are present in older children (aged 12 to 13 years), as children of this age can better conceptualize the COVID-19 situation, and they appear to be more worried and fearful about the disease (Khan et al., 2021; Smirni et al., 2020). In contrast, other studies have not observed that children's age affects the severity of psychological problems (Liu et al., 2020; Jiao et al., 2020). Similarly, the relationship between gender and the

presence of psychiatric symptoms in children remains controversial. Studies in both the United States and China have suggested that girls are at higher risk of experiencing symptoms of depression and anxiety (Zhou et al., 2020; Oosterhoff et al., 2020), although the findings of Xie et al. (2020) do not confirm this.

3.1.2. For children and adolescents not infected by COVID-19

Lifestyle changes. The measures that were taken to control the spread of the virus also severely affected the lives of children not infected by COVID-19, which may have had serious effects on their mental health. First, school closures and limited outdoor recreation due to social isolation severely reduced children's social interactions. Since peer relationships play an important role in social development, this may have negatively impact on the children's mental health (Fegert et al., 2020). Schools in particular are critical for children and adolescents. Schools provide not only education but also access to health services for students (Golberstein et al., 2020). Second, schools can offer lunch to improve the nutritional status of students. School closures due to the pandemic may have a negative impact on the nutritional status of vulnerable children around the world (Hecht et al., 2022).

Parental stress and its influence on the parent-child relationship. The COVID-19 pandemic has led to changes in the daily life of families. Due to social isolation, these families need to change the way that they used to work and study to cope with these changes by working and studying at home. Parents working at home and caring for their home-schooled children at the same time increases however increases their stress (Fegert et al., 2020). Parents are also tasked with informing and explaining the COVID-19 pandemic to their children and addressing their fears and anxieties. This can cause significant stress and psychological distress for all family members. The financial burden on families caused by the pandemic predicts higher levels of anxiety and depressive symptoms (McKune et al., 2021). Parental mental illness and substance abuse also increase the risk of mental health problems in children (Rasic et al., 2014). Economic hardship due to reduced or lost income leads to financial stress, marital conflict (Fegert et al., 2020), and potential neglect and abuse of children, all of which may have serious long-term consequences (MacMillan et al., 2013; Hillis et al., 2017). On the contrary, a good parent-child relationship protects children's mental health (Cooper et al., 2021), and adolescents with good parent-child relationships have been found to be at lower risk of mental health problems (Cooper et al., 2021; Wang et al., 2021).

Screen time and social media usage. Screen time increased during the pandemic as many activities, including education, were conducted virtually (Muzi et al., 2021). Social media usage also increased (Cauberghe et al., 2021; Duan et al., 2020). Although studies have shown that social media is useful for maintaining social relationships and coping with anxiety and isolation, the excessive use of the internet may also have a negative impact on children's health (Cauberghe et al., 2021). Studies have shown that excessive screen time was associated with to a variety of health risks, including decreased the quality of sleep, increased cardiovascular disease, and psychological problems such as anxiety and depression (Nagata et al., 2020). Inappropriate use of social media and video game can lead to more problems related to emotional and behavioral symptoms, such as delinquency and inattention, and abnormal behaviors, such as overeating (Muzi et al., 2021). Unrestricted use of the internet can pose risks, including cyberbullying and exposure to unsuitable material, e.g., violence or sexual content (Copp et al., 2021). Social media and the inevitable exposure to pandemic-related news may have a negative impact on both anxiety and depression (Wang et al., 2020).

3.2. COVID-19 and the mechanism of neuroendocrine-immune dysregulation

It is believed that stress is usually generated by external or internal stimuli and causes physiological damage or psychological disturbance to the body (Gunnar and Quevedo, 2007). Research now supports that the COVID-19 pandemic acts as a stressor and has a negative psychological impact on quarantined groups of children and adolescents, which resulted in these individuals being more susceptible to long-term mental disorders, such as depression and anxiety (Chen et al., 2020). It has also been suggested that dysregulated interactions between the neuroendocrine and immune systems underlie many of the psychiatric symptoms observed in stressed populations. In acute stress, the hypothalamic–pituitary–adrenal (HPA) axis acts as a negative feedback mechanism to prevent the intensification of the inflammatory response (Del Rey and Besedovsky, 2017). However, intense and persistent stressful events during childhood or adolescence can affect the immune, endocrine, and neurological responses through abnormal functioning of the HPA axis and levels of inflammatory mediators in the brain, which predispose individuals to psychopathological disorders, e.g., anxiety and depression (Dahmen et al., 2018; Juruena et al., 2020; Brenhouse and Schwarz, 2016). Stress is a potential trigger for neuroinflammatory disorders. Neuroinflammation is often defined as a dysregulation of immune signaling in the brain that may lead to various diseases (Jiang et al., 2018; Calcia et al., 2016). Abnormal inflammatory changes caused by COVID-19 induced stress may also lead to long-term physical and psychological damage (de Figueiredo et al., 2021).

4. Screening instruments

The early identification of mental health issues in children and adolescents plays an important role in their treatment and prognosis. A simple and efficient screening tool is key. The following is a discussion of some common mental health screening tools for children and adolescents.

4.1. Screening instruments for anxiety

The most common psychiatric disorder experienced by children and adolescents is anxiety disorders. If anxiety is identified at an early stage, children can receive treatment before symptoms worsen and can mitigate the negative effects on social functioning, including poor academic performance and school attendance, depression, and substance abuse (Runyon et al., 2018). But the fact is that childhood anxiety disorders are under-recognized (Gyllenberg et al., 2014; Wölflé et al., 2014). And most children with anxiety disorders rarely receive relevant treatment in time (Lempinen et al., 2019; Gyllenberg et al., 2014). For this reason, effective screening methods are essential to identify children in need of treatment. In order to address this need for early identification and referral of anxious children, the following will discuss clinically used tools that have been proven to be reliable in assessing anxiety in children.

4.1.1. The screen for child anxiety related emotional disorders (SCARED)

The SCARED questionnaire is widely used to assess childhood anxiety (Runyon et al., 2018; Birmaher et al., 1997). The self-reported SCARED (Birmaher et al., 1997) questionnaire evaluates anxiety symptoms in children between the ages of 9 and 18 years. The scale includes 41 items, and the child or parent is requested to report the symptom frequency on a 3-point scale, namely, 0 (almost never), 1 (sometimes), or 2 (often). The reliability is 0.993. SCARED has been assessed in numerous studies and has been found to be reliable for screening anxiety disorders in children (Runyon et al., 2018; Hale et al., 2011) even in different countries and cultures and after the DSM-5 revision of the diagnostic criteria.

4.1.2. The multidimensional anxiety scale for children (MASC)

The self-reported MASC is also used for anxiety screening in children (March et al., 1997). The instrument is completed by the child and comprises four sections, specifically, social anxiety, harm avoidance, separation anxiety, and physical symptoms. The instrument also includes a total anxiety score, the Anxiety Disorder Index, which is used to identify children who need further clinical evaluation. The internal consistency of the MASC total anxiety score ranges from 0.87 to 0.89.

4.1.3. Spence children's anxiety scale (SCAS)

The SCAS (Spence, 1997) is one of the most commonly used anxiety scales by researchers and clinicians (Orgilés et al., 2014). The SCAS is designed to evaluate the severity of anxiety symptoms in children between the ages of 8 and 17 years. The scale includes six domains, namely, generalized anxiety, panic/agoraphobia, social phobia, separation anxiety, obsessive-compulsive disorder, and fear of physical injury. It has a total of 44 items, each with a score of 4 that ranges from 0 (never) to 3 (always). Of these, 38 items reflect specific anxiety disorder symptoms, including panic attacks and agoraphobia (PA; 9 items), separation anxiety disorder (SAD; 6 items), obsessive-compulsive disorder (OCD; 6 items), social phobia (SP; 6 items), generalized anxiety disorder (GAD; 6 items), and fear of physical harm (PIF; 5 items). The remaining six items are positive fillers, such as reduced response bias, that are not included in the scoring process (Spence, 1998). The SCAS has been used in a large number of studies to assess anxiety symptoms (Orgilés et al., 2016). Numerous studies have also validated the SCAS in children and young adults, which demonstrates its internal consistency, retest reliability, convergent and divergent validity, and ability to differentiate between children with anxiety disorders and community samples (Arendt et al., 2014; Orgilés et al., 2016). It is considered reliable for cross-cultural use (Orgilés et al., 2016).

4.2. Screening instruments for depression

Although the recognition of depression may require clinicians to conduct multiple consultations with patients in a trust-building context, validated assessment tools can help clinicians identify and routinely monitor patients with depression. A variety of screening tools are available that vary in style, validity, and feasibility. This article discusses the following depression assessment tools relevant to children for clinicians to choose from.

4.2.1. Children's depression inventory (CDI)

The CDI is a widely used self-report inventory for assessing depression in school-aged children (Matthey and Petrovski, 2002). The CDI is used to detect depression in children aged 7 to 17 years. It contains 27 items, each of which consists of three choices that are graded in order of increasing severity, from 0 to 2. It is written in simple language (grade 1 reading level) and asks the child to choose a sentence from three options that best describe him or her in the past two weeks. The questionnaire covers questions pertaining to negative mood, interpersonal problems, ineffectiveness, anhedonia, and negative self-esteem. The CDI has been shown to discriminate between clinically depressed and nondepressed psychiatric patients (Lobovits and Handal, 1985).

4.2.2. Beck depression inventory (BDI)

The BDI is used to evaluate depression in people over the age of 13 years, including adults (Snijders et al., 2006). It contains 21 items, and the BDI yields a total score, with the severity of depression determined by the score. A score of 10 is used as a threshold for depression, with scores between 10 and 16 indicating mild depression, scores between 17 and 29 indicating moderate depression, and scores between 30 and 63 indicating severe depression (Borner et al., 2010).

4.2.3. Patient health questionnaire (PHQ)

The PHQ is a commonly used screening tool for depression. It has

good effectiveness, reliability, and simplicity and includes Patient Health Questionnaire 2-item depression screen (PHQ-2) and Patient Health Questionnaire 9-item depression screen (PHQ-9) (Ferenchick et al., 2019). The PHQ has been shown to have good diagnostic validity and considerable sensitivity and specificity (Spitzer et al., 1999). The PHQ-2 is often used as a first step in screening for depression, with further additional assessment required by the PHQ-9. Additionally, the PHQ is free and available to the public. Similarly, the PHQ is equally suitable as a first-line tool for evaluating depression in adolescents with good sensitivity and specificity, as assessed by Richardson et al. (2010a, 2010b).

4.3. Screening instruments for PTSD

Untreated PTSD is a significant risk factor for mental health problems, substance abuse, and suicide (Chapman and Ford, 2008). Early identification of PTSD is key to reducing these risks, and reliable and efficient PTSD screening and diagnostic tools are necessary.

4.3.1. The UCLA PTSD reaction index for DSM-IV (PTSD-RI)

The PTSD-RI is one of the most widely used tools to assess post-traumatic stress reactions and predict PTSD status in trauma-exposed children and adolescents (Kaplow et al., 2020). The new version is a semistructured interview that assesses a child's trauma history and provides a full range of DSM-5 diagnostic criteria for PTSD among school-age children and adolescents. The reliability was 0.989.

4.3.2. Child and adolescent trauma screen (CATS)

The CATS (Sachser et al., 2017) is a short, freely available questionnaire used to identify potentially traumatic events (PTE) and PTSD. The questionnaire was designed according to the DSM-5 PTSD criteria and includes items that correspond to criteria B (intrusion), C (avoidance), D (negative changes in cognition and mood), and E (extreme arousal). Checklists of 15 and 20 items assess trauma exposure and PTSD symptom frequencies over the previous month, respectively, while impairments in psychosocial functioning are measured by 5 dichotomous items. The CATS has satisfactory psychometric properties and is used to both screen for and monitor symptoms (Sachser et al., 2017). It has been translated into various languages, and studies have shown that it exhibits good to excellent reliability in terms of internal consistency (Kaplow et al., 2020).

4.3.3. Child PTSD symptom scale (CPSS)

The CPSS is used to assess PTSD symptoms in children between the ages of 8 and 18 years who have experienced trauma, as defined by the DSM-IV criteria (Foa et al., 2018). The CPSS for DSM-5 (CPSS-5) (Foa et al., 2018), which is based on the original CPSS, is used to evaluate PTSD symptoms over the previous month and can be used as either a self-report questionnaire or as a semi-structured interview. The CPSS-5 evaluates the trauma history in an open-ended manner to determine the index trauma. The scale comprises 20 items for assessing the PTSD symptom frequency and 7 items for assessing the degree of daily functional impairment. Studies have shown that the CPSS has excellent internal consistency and good-to-excellent test-retest reliability. The self-report and interview versions also show convergent validity and diagnostic consistency (Kaplow et al., 2020).

5. Intervention or prevention

Childhood is a vulnerable stage of life, which emphasizes the importance of psychological interventions for children in crisis situations to prevent the development of mental health problems. Early engagement appears to be critical in preventing long-term adverse developments such as substance abuse, poor academic performance, and violence. The following are intervention methods for children and adolescents with psychological problems.

5.1. Cognitive behavioral therapy (CBT)

CBT is the most widely used technique for treating anxiety and affective disorders. It includes a variety of psychotherapeutic strategies, including cognitive restructuring, psychoeducation, and exposure to feared stimuli both in real life and by using imaginative exercises in conjunction with breathing and relaxation techniques (Craske et al., 2017). CBT has been proven to be effective in individual, group, and family models in a number of studies (Boldt et al., 2021). CBT is primarily conducted through face-to-face communication, but can also be conducted through virtual networks (Grist et al., 2019; Välimäki et al., 2017). CBT programs supported by interrogative evidence and conducted through scalable networks have great potential during pandemic and in post-pandemic recovery (Boldt et al., 2021). There is an absence of corresponding researches confirming the long-term impact and economic benefits of network-based intervention methods for patients.

5.2. Training for awareness, resilience, and action (TARA)

TARA is a 12-week semi-manualized group training that uses mindfulness and yoga-based approaches together with modern psychotherapeutic techniques that have been found to assist in the development of neural circuits in adolescent brains (Henje Blom et al., 2014). TARA addresses the main functional areas of depression and involves developmental and neurobiological features. TARA has been demonstrated to be effective in treating both anxiety and depression (Henje Blom et al., 2016).

TARA is organized according to the factors considered to drive the psychopathology. Initially, the hyperactivity of the amygdala is addressed through techniques that produce increased vagal activity. This is followed by training in interoceptive awareness and techniques to develop metacognition, compassion and care for both the patient and others. The final step is value-based behavioral activation (Ekbäck et al., 2021). Specific target areas are sustained threats, sleep and arousal, and attention and cognitive control. The training thus includes techniques of autonomic and emotional self-regulation, relational skills, interoceptive attention, and value-based actions. The program also integrates various traditions and paradigms (Tymofiyeva et al., 2021).

5.3. Self-directed (SD) parenting interventions

Parenting interventions are recognized as an effective treatment for reducing externalizing behavioral symptoms (Furlong et al., 2012). Children in unhealthy home environments often exhibit higher levels of externalizing behaviors, and research also suggests that poor parenting practices can maintain or exacerbate the development of disruptive behaviors (Johnston and Mash, 2001; Deault, 2010). Parenting interventions aim to intervene in children's psychology through a prevention-based psychological approach to reduce family stress, improve parent-child emotions, interpersonal interactions and parenting skills. Examples include changing parental behavior and teaching behavior management strategies such as praising good behavior while ignoring minor undesirable behavior (Boldt et al., 2021; Tarver et al., 2014). SD parenting interventions are based on parental intervention, that provide caregivers with support and materials to positively influence behavior through varying degrees of therapist support for parenting intervention principles at home and a time most convenient time (Boldt et al., 2021). Studies have shown that SD parenting interventions and online and offline models based on SD interventions have shown considerable effectiveness (Tarver et al., 2014; Comer et al., 2017; Baker et al., 2017). It is hypothesized that online parent support programs offer great potential to help families in major crises as in the COVID-19 pandemic.

5.4. Other interventions and prevention methods

Physical activity-based interventions have also been shown to be effective in reducing anxiety levels and depressive symptoms (Rodríguez-Ayllon et al., 2019; Stubbs et al., 2017). Increased awareness of coronavirus disease can prevent symptoms of depression and anxiety (Zhou et al., 2020). Activities such as parent-child activities, reading, and media entertainment can help children reduce the mental stress associated with the pandemic (Jiao et al., 2020). Social and community support can reduce mental health risks (Jia et al., 2021). Internet-based remote interventions are playing an increasingly important role in the context of strict isolation measures as the epidemic progresses (Heckendorf et al., 2022; Dixon et al., 2016). Increasing evidence suggests that child and adolescent mental health network interventions have better feasibility, acceptability, and effectiveness (Korpilahti-Leino et al., 2022; Currie et al., 2022). Numerous organizations have created online tools and specific interventions to help young children cope with stress and mental health issues during the pandemic (Meherali et al., 2021). WHO has designed a tool called “Helping Children Cope With Stress During the 2019-nCoV Outbreak” (WHO, 2020). Multiple organizations around the world have developed phone and text messaging services (Bonardi et al., 2022).

The effects of medication and psychotherapy for mental health disorders in children and adolescents are approximately similar (Bandelow et al., 2015). Adverse events with medication are, most of them, not serious and common, whereas with psychotherapy they are not (Wang et al., 2017). And in terms of adherence, psychotherapy is more advantageous (Wang et al., 2017). Although medications such as selective serotonin reuptake inhibitors (SSRIs) and serotonin–noradrenaline reuptake inhibitors (SNRIs) were also found to be effective in the treatment of mental health disorders in children and adolescents (Locher et al., 2017), but the application of medication to preschool children remains controversial. Several studies suggested that fluoxetine was tolerable and effective in preschool children with anxiety disorders, but with a high incidence of adverse events (Zuckerman et al., 2007; Coskun and Zoroglu, 2009). Therefore, psychopharmacological interventions were not recommended as first-line treatment for depression and anxiety disorders in preschool children. This is largely because these agents have not yet undergone the needed empirical testing in preschool children, and their efficacy, safety, and effects on growth and development have not been assessed and remain unknown (Luby, 2013).

6. Conclusion

This review provides insight into the impact, mechanisms, and influences of the COVID-19 pandemic on the mental health of children and adolescents, together with a comprehensive overview of the screening tools and prevention and interventions. We emphasize the necessary attention to children and adolescents and proactive action to develop a comprehensive and reliable program plan so that the mental health risks of COVID-19 in children and adolescents can be mitigated in a timely manner.

CRedit authorship contribution statement

Miao-Shui Bai: Writing – original draft, Writing – review & editing. **Chun-Yue Miao:** Writing – review & editing, Formal analysis. **Yu Zhang:** Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Yang Xue:** Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Fei-Yong Jia:** Visualization, Writing – original draft, Writing – review & editing. **Lin Du:** Visualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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