

Psychosocial impact of respiratory infectious disease pandemics on children: a systematic review

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Abstract

Objective

To examine the impact of respiratory infectious disease pandemics in the new millennium on mental health, behavioral responses, and parenting practices in children, and provide further intervention directions to mitigate negative effects of the 2019 novel coronavirus disease (COVID-19).

Methods

We conducted a systemic literature review of researches from January 2003 to May 2020 with three mainstream electronic databases including PubMed, Web of Science, and China National Knowledge Infrastructure. Quality of included studies were assessed using Agency for Healthcare Research and Quality (AHRQ), Newcastle-Ottawa Scale (NOS), and Critical Appraisal Skills Programme (CASP) according to different study design. Further directions were identified for developing appropriate interventions.

Results

Twenty-four studies conducted in the context of severe acute respiratory syndrome (SARS) (n = 10), influenza A (H1N1) (n = 3), and COVID-19 (n = 11) pandemics met the inclusion criteria. Children showed emotional conditions such as anxiety, fear, and depression, while psychological responses varied across age and gender groups. Children with mental illness history experienced an exacerbation of psychological symptoms. The pandemics changed hygiene habits and learning styles, and led to the increased participation in unfavorable lifestyles. For families with pediatric patients, the pandemic decreased parents' participation in providing family-centered care and threatened to supportive family relationship and effective parents-child communication.

Conclusion

The emerging virus outbreaks and subsequent disease-control measures have impacts on mental health status, behavioral responses, and parenting practices in children. In response to COVID-19, greater efforts taking into account children's developmental stage should be made to implement evidence-based psychological interventions, enhance effective communication, and encourage collaboration.

Introduction

Since the 2019 novel coronavirus disease (COVID-19) pandemic was declared in early March 2020, affected countries have been reporting their epidemiological data in close succession.^{1,2} As of June 30, 2020, there were more than 10.1 million COVID-19 cases worldwide, with the death toll rising to 0.5 million. In response to the COVID-19 outbreak, health authorities across the globe have launched a series of infection control measures including mobility restriction, school closure, home confinement, and quarantine/isolation for those with suspected/confirmed infection. Although the risk of infection has been effectively controlled, these mandatory public health strategies may have short- and long-term impacts on psychological state, behaviors, and family life^{3,4}, particularly in children who are in a vulnerable position in response to public health emergencies and have limited abilities to cope with their psychological issues.⁵

It is estimated that approximate 1.5 billion young people are out of education due to school closures; most of them are confined to their homes and are discouraged from public activities.^{4,6} For quarantined children who are infected with the disease or have close contact with confirmed patients, separation from parents and family members' death make them more likely to develop psychosocial disorders.⁷ Evidence has also indicated that psychological stress and economic impact of public health emergencies can increase the parenting hardship.⁸ However, most of the published literature on similar respiratory infectious disease pandemics in the new millennium, such as the outbreak of severe acute respiratory syndrome (SARS) in 2003, influenza A (H1N1) in 2009, and Middle East respiratory syndrome (MERS) in 2012, paid much attention on medical needs of patients, with the psychosocial impacts among children arousing insufficient attention.⁹⁻¹¹

In order to fully understand the psychosocial impact of COVID-19 pandemic and other similar events among children, we performed a systematic review of studies assessing the impact of emerging respiratory infectious disease outbreaks on mental health, behaviors, and parenting practices for children. Based on the evidence obtained from the comprehensive analysis, suggestions on further directions were made to inform health systems of tailored intervention strategies to improve children's well-being.

Methods

Inclusion and exclusion criteria

Context of diseases and health outcomes

The respiratory infectious disease pandemics sharing similar public health significance in the new millennium including SARS, influenza H1N1, MERS, and COVID-19 were included in this review. Studies must reveal the association between disease outbreaks and children's responses; the three main concepts of the psychosocial impacts were restricted to mental status, behavioral patterns, and parenting practices.

Types of participants

The review included participants aged < 18 years who experienced home confinement, quarantine, and isolation due to the above pandemics. Normal children, pediatric patients with suspected/confirmed infection, and those diagnosed with other diseases (such as pre-existing mental disorders, obesity, etc) were enrolled.

Types of studies

Original researches were eligible if the study performed quantitative and/or qualitative analyses. Those focusing on pathology, diagnosis, and treatment of diseases, systematic reviews, correspondence, and comments/editorials were excluded.

Search Strategy

We searched PubMed, Web of Science, and China National Knowledge Infrastructure for related publications dated within the past 17 years (January 2003–June 2020), using keyword combinations of the following three categories: respiratory infectious diseases (Serious Acute Respiratory Symptom, SARS, influenza H1N1, Middle East Respiratory Syndrome, MERS, 2019 novel coronavirus disease, and COVID-19), participants (children, child, adolescents, and youth), and health outcomes (psychosocial situation, psychological situation, mental health, social behaviors, parenting practices, nurturing care, and early development). More details are listed in the **Additional file 1**. The reference lists of included studies were also reviewed. Citations were downloaded to NoteExpress and duplicates were removed. The process of study search and selection is shown in Fig. 1.

Data Collection And Analysis

Selection of studies

The first author screened titles and abstracts of literature according to the search strategy. The full-text of studies were independently reviewed by the first and second author, and were identified to be included or excluded. Disagreements were resolved by all authors through discussion and consensus.

Data extraction and management

The following information from included studies were extracted using a structured work sheet: (1) study characteristics (ie, first author, publication year, country/ region, study design, sampling method, the context of disease, research method, scale, main findings, and conclusion); (2) participant characteristics (ie, health status, age, and sample size).

Assessment of quality of included studies

We assessed quality of cross sectional and follow-up studies using the Agency for Healthcare Research and Quality (AHRQ)¹², where studies received summary scores of low (0–3 points), medium (4–7 points), and high (8–11 points). The Newcastle-Ottawa Scale (NOS)¹³ was performed to assess quality of the case-control study, and Critical Appraisal Skills Programme (CASP)¹⁴ checklists were used to appraise qualitative studies, with a higher score indicating better quality. Consensus was reached on all included studies.

Measure of impact

No calculations were performed. Quantitative data was presented in the format of mean and standard deviation (*SD*) with 95% confidence intervals (*CI*), proportion, and rate, if provided. Results with $P > 0.05$ were reported as not significant. Descriptive narratives of qualitative data were summarized to reveal the experiences and recollections of children and caregivers.

This review used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)¹⁵ as a guide, and the PRISMA checklist was included in the **Additional file 2**.

Results

Study overview

Twenty-four studies meeting the eligibility criteria were included in this review, with ten studies being conducted in the context of the SARS outbreak, three in influenza A (H1N1), and eleven in COVID-19. Research locations included mainland China (10), Hong Kong Special Administrative Region of China (4), Italy (3), Canada (2), America (2), Netherlands (1), UK (1), and India (1). The studies categorized by topic of interest are shown in Table 1.

Table 1
Original studies categorized by theme

Focus	Topic	Number
Mentality	Anxiety, fear, depress, and traumatic stress	5
	Gender disparities in psychological stress	6
	Age disparities in psychological stress	3
	Exacerbation of pre-existing mental health disorders	4
	Emotional needs	4
	Medium-term psychological effects	2
	Dual effects of media	5
	Other impact factors	3
Behavior	Hygiene behaviors	5
	Lifestyle behaviors	3
	Associations between behavioral motivations and mental health	1
	Learning adaptability	1
Parenting	Separation anxiety	5
	Emotional connection	4
	Family relationship	3
	Family participation	2
	Communication challenges	4
Legend: The included studies were categorized by 3 topic of interest: mentality, behavior, and parenting.		

Methods Of Included Researches

Sixteen quantitative and six qualitative studies were identified for inclusion, while the other two studies used a combination of quantitative and qualitative approaches. Of the sixteen quantitative studies, fifteen were cross-sectional studies and one was follow-up study, in which statistical methods were adopted to explore the relationship between the epidemic and psychological responses. Telephone interview, semi-structured interview, and case report were implemented in qualitative studies to identify the health effect on behavioral patterns and parenting practices. Detailed information of each included study are demonstrated in Table 2.

Table 2
Summary of included studies

Citation	Country/region	Study design	Sampling method	Children's health status	Age	Sample size	Background disease	Research method	Sc
Meiru Xu et al., 2003	China/Beijing	Cross-sectional study	Simple random sampling & Systematic sampling	Norm	14 ~ 16 years	238	SARS	Telephone interview	Sc
Chi-wai Leung et al., 2004	China/Hong Kong	Follow-up study	Clinical case	Infected	< 18 years	41	SARS	Telephone interview; Psycho-education; Psychological functioning screening	Sc
Albert M. Li et al., 2004	China/Hong Kong	Qualitative study	Not mention	Infected	7 ~ 13 years	4	SARS	Semi-structured interview	Sc
Xiaoying Lu et al., 2005	China/Beijing	Cross-sectional study	Cluster sampling	Norm	9 ~ 16 years	96	SARS	Telephone interview	Sc
Hongling He et al., 2005	China/Xian	Cross-sectional study	Random sampling	Norm	Fourth to sixth grades	1811	SARS	Questionnaire	Zu de (S rai sc
Hongling He et al., 2006	China/Xian	Cross-sectional study	Random sampling	Norm	Fourth to sixth grades	1758	SARS	Questionnaire	Zu de (S rai sc Ey Pe Qu (Ei
Sophia SC Chan et al., 2006	China/Hong Kong	Qualitative study	Electronic medical records	Suspected	1 ~ 16 years	66	SARS	Case review; Meetings; Interviews	Sc

*E: Extroversion and introversion on Eysenck Personality Questionnaire (EPQ)

Legend: Table 2 shows detailed information of each included study.

Citation	Country/region	Study design	Sampling method	Children's health status	Age	Sample size	Background disease	Research method	Sc
Sophia SC Chan et al., 2007	China/Hong Kong	Qualitative study	With invitation	Suspected	Not mention	7	SARS	Semi-structured interview	Nc
Donna Koller et al., 2010	Canada	Qualitative study	Electronic medical records	Suspected; With other diagnoses	5 ~ 19 years	21	SARS	Semi-structured interview; Medical records	Nc
Danielle Remmerswaal et al., 2011	Netherlands	Cross-sectional study	With invitation	Norm	7 ~ 12 years	223	Influenza H1N1	Questionnaire	Fe Qu (F: Inf Sv (S Su fo Re
LISA A. PAGE et al., 2011	UK	Case-control study & Qualitative study	Electronic medical records	With pre-existing mental health disorders	Not mention	144	Influenza H1N1	Not mention	Nc
Ginny Sprang et al., 2012	America/Arizona, California, Florida, New York, Texas, Kentucky; Mexico/Mexico City; Canada/Toronto	Cross-sectional study & Qualitative study	Not mention	Infected	Not mention	398	Influenza H1N1 (91%); SARS (8%); Avian influenza (1%)	Questionnaire; Focus group; Semi-structured interview	Di In Pa PT Ci (P
Donna F. Koller et al., 2015	Canada/Toronto	Qualitative study	With invitation	Infected	< 6 years; 6 ~ 18 years;	23	SARS	Interviews; Patient health care record	Nc
Shaowen Li et al., 2020	China/Shanxi	Cross-sectional study	Snowball sampling	Norm	8 ~ 18 years	396	COVID-19	Questionnaire	Sc Ar En Di (S

*E: Extroversion and introversion on Eysenck Personality Questionnaire (EPQ)

Legend: Table 2 shows detailed information of each included study.

Citation	Country/region	Study design	Sampling method	Children's health status	Age	Sample size	Background disease	Research method	Sc
Yue Wang et al., 2020	China/Shanxi	Cross-sectional study	Snowball sampling	Norm	8 ~ 18 years	396	COVID-19	Questionnaire	De rai Ch Sc Ar En Di (S
Angelo Pietrobelli et al., 2020	Italy/Verona	Cross-sectional study	Not mention	With obesity	6 ~ 18 years	41	COVID-19	Telephone interview	Se
Marco Colizzi et al., 2020	Italy/Verona	Qualitative study	Clinical case	With pre-existing mental health disorders	16 years	1	COVID-19	Case report	Nc
Jinsong Zhang et al., 2020	China/Shanghai	Cross-sectional study	With invitation	With pre-existing mental health disorders	6 ~ 15 years	241	COVID-19	Questionnaires	Sv an th Di: Ch
Kaiheng Zhu et al., 2020	China/Hubei	Cross-sectional study	Random cluster sampling	Norm	Second to sixth grades	1264	COVID-19	Questionnaires	Sc Ar En Di: (S Ra Sc
Kumar Saurabh et al., 2020	India/Bihar	Cross-sectional study	With invitation	Potentially exposed & Norm	9 ~ 18 years	252	COVID-19	Questionnaires	Nc
Benjamin Oosterhoff et al., 2020	the US	Cross-sectional study	Self-selected	Norm	13 ~ 18 years	683	COVID-19	Questionnaires	Pa Ou Mi Inf Sy an sc Int Ne Qu

*E: Extroversion and introversion on Eysenck Personality Questionnaire (EPQ)

Legend: Table 2 shows detailed information of each included study.

Citation	Country/region	Study design	Sampling method	Children's health status	Age	Sample size	Background disease	Research method	Sc
Marco Colizzi et al., 2020	Italy/Verona	Cross-sectional study	With invitation	With pre-existing mental health disorders	13 ± 8.1 years	527	COVID-19	Questionnaires	Nc
Shengyi Liu et al., 2020	China/Sichuan	Cross-sectional study	Cluster sampling	Norm	Fifth and sixth grades	209	COVID-19	Questionnaires	Sc rai
Shao Shanshan et al., 2020	China/Wuxi	Cross-sectional study	Cluster sampling	Norm	4.99 ± 0.9 years	2370	COVID-19	Questionnaires	Se

*E: Extroversion and introversion on Eysenck Personality Questionnaire (EPQ)

Legend: Table 2 shows detailed information of each included study.

Quality Of Included Researches

For the fifteen cross-sectional studies, twelve were considered to be of medium quality and three were high quality. The scores of qualitative studies ranged between 7 and 10 points, which indicated high levels of research quality, as did that of the two studies performing a combination of quantitative and qualitative approaches. The results of quality assessment for each included study in detail were shown in the **Additional file 3**. The risk assessment of potential bias for the present study as a whole was not applied because of the inconsistency of study design across studies.

Psychological Impact

Anxiety, fear, depression, and traumatic stress

The pandemics had negative psychological impacts on children. For children experiencing quarantine or isolation during the disease pandemic, anxiety was the most common psychological problem.^{16,17} A cross-sectional study in Shanxi Province of northwestern China found during the home confinement of COVID-19 outbreak, 22% and 10.4% of primary school students showed anxiety and depression symptoms, respectively.¹⁸ Depression was positively correlated with anxiety (*OR*: 4.28; 95% *CI*: 2.16, 8.49) and fear of COVID-19-related information (*OR*: 3.31; 95% *CI*: 1.21, 9.06).¹⁹ In addition, Ginny et al. observed significant differences in traumatic stress between children who did and did not experience isolation, with those who were quarantined due to SARS and influenza H1N1 showing post-traumatic stress disorder (PTSD)-related symptoms and received PTSD diagnosis at higher rates.¹⁶ Children's concern for life and health regarding COVID-19 was found to be related to the incidence of somatic symptoms.²⁰

Gender disparities in psychological stress

Many investigations observed significant discrepancies in psychological responses to pandemics between genders. A case-control survey conducted in Beijing during the SARS outbreak showed boys had higher levels of neurasthenia, compulsion, fear, depression, and negativity compared with girls ($P < 0.05$).^{21,22} However, using a logistic regression model, Li et al. and Zhu et al. found girls had an increased likelihood of being anxious (*OR* = 2.26 and 1.4, respectively) during the COVID-19 outbreak,^{17,18} which indicated that being more sensitive to pandemic-related coverage may exacerbate girls' psychological stress.^{23,24}

Age disparities in psychological stress

A significant correlation with psychological impacts was present for age. Based on Zung's self-rating depression scale (SDS) and Zung's self-rating anxiety scale (SAS), a quantitative investigation conducted in the context of SARS epidemic suggested that scores on dimensions of depression and passiveness in sixth-grade schoolchildren exceeded those from other grades.²² Similarly, older children appeared less fear of medical affairs, such as medical personal protective equipment (PPE), than younger children when they were hospitalized due to the 2009 influenza H1N1 pandemic.²⁴ However, a study in China showed that age was positively correlated with emotional distress ($\beta = 0.181$), with senior high school students getting the highest score on the dimension of depression in a self-rating scale.¹⁹

Exacerbation of pre-existing mental health disorders

Fearing of infection exacerbated pre-existing mental illness. A case-control study based on electronic records concluded that children with obsessive compulsive disorders had a higher likelihood (*OR*: 8.1; 95% *CI*: 3.0, 21.3) of expressing moderate/severe concerns about influenza virus than the norm peers.²⁵ Children who had a history of somatic symptom disorder (SSD), autism spectrum disorder (ASD), and attention deficit hyperactivity disorder (ADHD) were also reported to experience an exacerbation of psychological symptoms.²⁶⁻²⁸

Emotional needs

When children were isolated in the hospital, their psychological responses could be emotionally influenced by medical staff.²⁹ For instance, playthings and developmental games provided by medical workers could partly meet the emotional needs of pediatric patients, by which children's attention was diverted and the loneliness was handled.²⁹ Additionally, encouragement from peers made pediatric patients be more aware of the importance of friendship and social support.^{24,30} As Albert M. Li et al. found, the active interaction with new friends brought independence and courage to SARS-affected children during the hospitalization.³⁰ For children with pre-existing mental disorders, in-home healthcare support and center-based healthcare support were the two leading reported needs to manage their psychological distress.²⁸

Medium-term psychological effects

Pediatric patients with confirmed infection experienced more obvious psychological impacts than norm children.³⁰ A follow-up survey revealed that some young people who were recovered from SARS experienced temporary decreases in attention and memory, transient emotional instabilities, and emotional distress at 1 and 3 months after hospital discharge.³¹ But the short-term to medium-term psychological outcomes among pediatric patients were not evident.³¹

Dual effects of the media

Multimedia techniques provided hospitalized children with emotional supports and eased emotional distress.³² Most school children who were confined to their homes during the pandemic used online education resources to meet the educational requirements.³³ However, the mass media may also be considered a source of concern.^{24,25} The young were susceptible to social media coverage because they worried that the bad events reported in media would fall on their family, which dramatically triggered anxiety and panic.^{25,29}

Other impact factors

Individual personality, parents' occupation, and residence were also corresponded to children's psychological responses. Emotional instability was associated with increased psychological disorders, and the incidences of neurasthenia and hypochondriasis in children having extroverted personalities were much lower than those with introverted character.²² By applying a self-rating scale, He et al. found that school students whose mother were medical staff got higher scores in dimensions of neurasthenia, fear, and depression.²¹ Compared to children dwelling in urban, those in suburban and rural areas had an increased risk of depression (*OR*: 2.38; 95% *CI*: 1.12, 5.07).¹⁹

Behavioral Impact

Hygiene behaviors

The pandemic may improve children's hygiene behaviors.²³ Compared with the pre-pandemic period, children were more likely to collect epidemic information, focus on personal hygiene, cancel planned appointments, and avoid going to public places.^{25,29} But the proportion of children who were compliant with all protective measures was low (7.43%), and being prohibited from going out to socialize was the most difficult instruction for children to comply with.³⁴ The emerging virus outbreak may have adverse impacts on children with neurodevelopmental disorders. The outbreak of influenza H1N1 aggregated compulsive behaviors of the young with obsessive compulsive disorder (OCD), such as exaggerated hand washing and door handles cleaning.²⁵

Lifestyle behaviors

Children's daily routine and healthy movement were affected by school closures.³⁵ A longitudinal observational study in Italy suggested that the obese kids underwent unfavorable changes in dietary habits, increased sleep and screen time, and decreased participation in outdoor activities during the COVID-19 pandemic.³⁶ Compared with the pre-COVID-19 pandemic period, 65.4% of the enrolled preschool children experienced an increase of 10 min in total screen time per day, while the continuous screen time increased by 5 min in 1444 (60.9%) participants.³⁷

Associations between behavioral motivations and mental health

Oosterhoff et al. found the association between children's motivations to engage in social distancing during the COVID-19 pandemic and psychological responses. Children's various motivations (such as social responsibility, avoid others sick, avoid being judged, and parental rules) to engage social distancing were closely correlated with anxiety symptoms, depressive symptoms, burdensomeness, and belongingness.³⁸

Learning adaptability

High school students self-rated that they experienced decreased learning efficiency during the SARS outbreak, but no statistically significant differences were observed between students in different grades. However, there were discrepancies in learning satisfaction, with children in senior schools being less satisfied with learning states than those from primary and junior schools. The major reasons for the learning dissatisfaction included unavailable in-person guidance from teachers, lack of interaction with peers, and decreased learning efficiency due to school closures. Importantly, some children improved their self-learning abilities and were more conscious of the value of school life than before.³³

Parenting Practices

Separation anxiety

Hospitalized children with suspected/confirmed infection expressed dramatically emotional distress due to separation from their family members.^{29,32} In an in-depth semi-structured interview conducted in Canada, most children with suspected SARS felt lonesome and experienced separation anxiety when they were separated from parents. A deep sense of insecurity was also a concern for children when they were left alone during the hospitalization.^{30,39} Additionally, the confliction from the responsibility to obey isolation procedures and fear of being separated from children accelerated parents' concern.⁴⁰

Emotional connection

Psychological responses between children and parents were positively related.^{16,30} A positive association in PTSD symptoms between parents and children experiencing SARS and influenza H1N1 pandemics was observed, with most pairs meeting the clinical cutoff score for PTSD diagnosis simultaneously.¹⁶ The transmission of threat information from parents to kids was considered the leading contributor to children's psychological stress. Based on a regression model, Danielle Remmerswaal et al. found that the negative news about influenza H1N1 provided by parents acted as a mediator in the relation of parents' and children's fear, while the discrepancy in transmission patterns was not observed between parents.²⁴ Families with ASD children were reported to be under more stress and anxiety than those without neurodevelopmental disorders.²⁸

Family relationship

The mandatory separation between hospitalized children and other family members impeded the establishment of the supportive family relationship and provision of family-centered care.^{29,32} However, a semi-structured interview conducted in Hong Kong demonstrated that the emerging virus outbreak had a positive impact on family relationships. Compared with the pre-pandemic period, pediatric SARS patients were more concerned with the health status of caregivers and it was much easier to establish effective child-parents communication after hospital discharge.³⁰

Family participation

For families with hospitalized pediatric patients, infection control measures decreased family participation in providing family-centered care.³⁹ As a retrospective cohort study evaluating the provision of nursing care in the SARS epidemic period showed, family-centered care was disturbed by the forbidden admission to wards.³⁹ During the hospitalization, the medical worker acted as a substitute caregiver for children and played an important role in providing essential family-centered care.³² The loss of parenting role due to being separated from children also decreased parents' participation.³²

Communication challenges

The pandemic outbreaks presented considerable challenges to effective communication between pediatric patients and parents. Because of limited sources of updated information, mobile phones became the only tool available to hospitalized children to communicate with the external world and get emotional supports.^{29,30,32,40} In addition, some compulsory infection control measures, such as isolation and PPE-wearing, undermined the effective communication between hospitalized children, family members, and medical workers, which in turn exacerbated fear and depression in children.^{29,32}

Discussion

The COVID-19 outbreak poses increasing threat to health and economy, which has become a global public health challenge. During epidemics, the vulnerable children may suffer "secondary pandemic" as a result of mandatory infection control measures implemented by national health authorities.⁴¹ Although children who were affected with COVID-19 developed less severe clinical symptoms than adults or seniors with underlying chronic diseases, the psychological stress and behavioral problems caused by the pandemic cannot be ignored.⁴² Besides children's emotional and social vulnerabilities being directly and indirectly affected by diseases, the economic impact of infectious outbreaks on caregivers may lead to the increased parenting hardship and disrupt family's routine life, especially vulnerable families from low-income countries with restrained health resources.^{4,43,44} The need to attenuate the adverse effect of COVID-19 pandemic on children should be considered a high priority for their welfare.

Based on our comprehensive review of early experience of COVID-19 and previous respiratory infectious disease pandemics in 21st century including SARS and influenza H1N1, we highlight the importance of consideration of children's need when developing intervention strategies targeted to children and caregivers in response to the COVID-19 pandemic.

Children with pre-existing mental disorders

Children with neuropsychological developmental disorders are more sensitive to disease-related information and are more likely to display behavioral problems.^{26,27} Guideline-recommended strategies for those with pre-existing mental illness, such as ADHD and ASD, are therefore needed to be reinforced to manage children's disruptive behaviors.⁴⁵ Since national social distancing measures present considerably increased challenges to children with a mental illness history, mental training programs that help healthcare professionals deliver timely psychotherapy to children in poor mental health conditions should be implemented in the face of COVID-19 crisis.⁴⁶ To minimize children's emotional distress and improve their long-term physical and psychological well-being, we also highlight the need of timely surveillance and targeted interventions according to their medical conditions.⁴⁷

Online health services

The network and smart phone apps popularize the provision of online mental health services in the pandemic situation.⁴⁸ Online mental health courses, psycho-education materials, and psychological consultation according to children's physical and mental characteristics are considered effective psychosocial interventions during the crisis.^{49,50} Therefore, providing telemental health services through online platforms is expected to be extensively developed to meet children's psychological needs.^{2,51} Additionally, psychologists, psychiatrists, and community volunteers are advocated to provide individual counseling and professional assistance via online platforms for confined children during school closures.^{7,52}

Information sharing

For families with children with suspected/confirmed infection, providing family members with updated information about their hospitalized kids' health condition is of great importance to highlight the essential role as caregivers that they played in the process of performing parenting practices and to enhance effective communication.^{29,32} More importantly, keeping children updated pertaining to the accurate explanation of the course of disease can serve as a useful approach to alleviate their psychological stress.^{2,53} The developmental stage and comprehension skills are the two leading considerations when parents conduct an emotion-focused communication with their children.⁵³

Collaboration among stakeholders

During such infectious outbreaks, parents, community workers, and medical personnel should work collaboratively to provide essential family-centered care for affected children, while parenting practices are expected to be improved accordingly.^{32,48} In addition, online parenting resources provided by World Health Organization (WHO) and United Nation's Children's Fund (UNICEF) are encouraged to build a harmonious relationship between parents and children, and to reduce parenting stress during the home confinement.⁴ Overall, it is the responsibility for parents, schools, societies, and health care systems at the national, provincial, and local level to mitigate the negative effects of infectious outbreaks on children.

Strength And Limitations

Compared with previous pandemics such as SARS and influenza H1N1, COVID-19 spreads more widely in the world. However, not much is known about its health effects on children. Based on current evidence of emerging virus outbreaks, we comprehensively summarized the findings about psychological, behavioral, and parenting impacts, and identified further directions to assist health authorities to enhance the well-being of children. The results can serve as a reference to provide better psychological care and family-based services for children under similar situations.

This review has some limitations. Most original studies included were cross-sectional study and semi-structured interview, where medium- and long-term psychological and behavioral consequences in children cannot be regularly monitored and assessed. In addition, since the incidence and mortality rates of the epidemics varied across locations, and research approaches and study design were inconsistent, potential bias in original articles might prevent accurately examining the health outcomes.

Conclusions

The emerging virus outbreaks and subsequent disease-control measures have direct impacts on mental health status, behavioral responses, and parenting practices among the pediatric population. In response to COVID-19, greater efforts taking into account children's developmental stage should be made to implement evidence-based psychological interventions, enhance effective communication, and encourage collaboration. This review provides important insights when tailoring targeted strategies to reduce the adverse impact of COVID-19 outbreak on children.

Abbreviations

COVID-19: 2019 novel coronavirus disease; SARS: severe acute respiratory syndrome; MERS: Middle East respiratory syndrome; SD: standard deviation; CI: confidence intervals; AHRQ: Agency for Healthcare Research and Quality; NOS: Newcastle-Ottawa Scale; CASP: Critical Appraisal Skills Programme; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis; PPE: personal protective equipment ; ADHD: attention deficit hyperactivity disorder; SDS: self-rating depression scale; SAS: self-rating anxiety scale; SSD: somatic symptom disorder; OCD: obsessive compulsive disorder; ASD: autism spectrum disorders; WHO: World Health Organization; UNICEF: United Nation's Children's Fund

Declarations

Availability of data and materials

All data analyzed during this study are available in the article and its additional files.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests

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None.

Authors' contributions

Dr. Tao Xu conceptualized and designed the study and critically reviewed and revised the manuscript for important intellectual content. Chenran Wang conducted the initial literature search and title /abstract screen, participated in the full-text screen, data extraction, and quality assessment, and drafted the first manuscript. Shuyue Xiao, Yijie Sun, and Jinpeng Wang participated in the full-text screen, data extraction, and quality assessment. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Figures

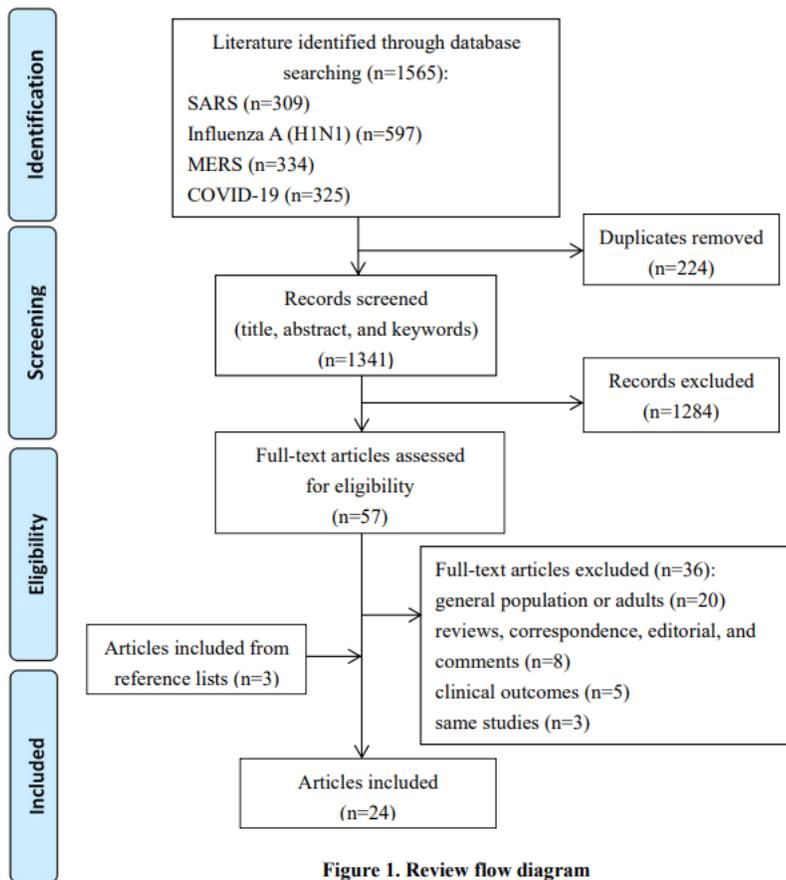


Figure 1

Review flow diagram. The figure shows the process of study search and selection.

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