

Systematic review

The impact of COVID-19 pandemic on child development: systematic review

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ABSTRACT

The Coronavirus disease 2019 (COVID-19), emerged as a global health issue in December 2019 which lead to the sudden implementation of social distancing norms worldwide, including school closures. This stress scenario can alter physical activity and sleep, which are shown to have a profound impact on brain plasticity. The PubMed, Europe PMC, Google Scholar and Science Direct database was searched between July 1st 2022 and September 20th 2022. The inclusion criteria was a) articles in English, b) Articles with study population as children and the exclusion criteria was a) Articles whose full text couldn't be obtained, b) journals not accessible online. After thorough analysis of 2371 records and removing the studies following the exclusion criteria, a total of 7 studies were included in this review. The results of these studies were tabulated. Among the 4.4 million COVID-19 deaths reported in the MPIDR COVerAGE database, 0.4% occurred in children and adolescents under 20 years of age. Expectant mothers were reluctant to attend clinics and were delayed in seeking treatment, due to the fear of being exposed to the virus. Maternal stress is thought to affect early structures of the developing limbic system. These can be potentially related factors and causes of neuropsychiatric disorders in children. Due to the protracted lockdown's impact on the economy, food shortages and an increase in food prices resulted in children not receiving the required nutrients. Before being confined to the home, toddlers had more opportunity to advance their motor development at a more complex level while acquiring more communication structures. Information about the impact of lockdown due to an epidemic on motor development of children is relevant to policy makers to aid them in developing strategies to help children cope with epidemic/pandemic-driven adversity and ensure their healthy development.

Keywords: SARS-CoV-2, CoV2, COVID-19, Pandemic, Child development, Adolescents

INTRODUCTION

Severe acute respiratory syndrome Coronavirus-2 (SARS-CoV-2), which causes the Coronavirus disease 2019 (COVID-19), emerged as a global health issue in December 2019. The emergence of a novel infectious disease, with high infectivity rates, lead to the sudden implementation of social distancing norms worldwide. Although this proved to curb the spread of the disease, it also led to a high incidence of mental health illnesses such as anxiety, depression, and panic attacks in people. It is known that a disruption in the socio-environmental factors at home can have harmful effects on the overall development of children and adolescents.² It has been

known that genetic predispositions are modified by environmental influences such as the stress produced by the pandemic.¹ This stress scenario can alter physical activity and sleep, essential for general development which are shown to have a profound impact on brain plasticity and, therefore, on cognitive and emotional development.² Despite the COVID-19 disease having a low mortality in children, they experienced the earliest and the most stringent social and physical restrictions during the pandemic in the form of school closures. The pandemic was rightly said "social crisis in the making" for today's children.³ In India, school closure has affected approximately 264.5 million children and around 108 million children were out-of-school due to the pandemic.

The Anganwadi Services Scheme, one of the world's largest and unique initiatives, that caters to early childhood care and development was closed across the country during the pandemic. These centers provided early childhood care, non-formal pre-school education to children, and training to parents and caretakers about early stimulation activities for psychosocial development of children from birth up to 3 years of age to around 24 million children between the ages of 3 to 6 years in 2020 before the lockdown. An increased screen time in children during the lockdown was found to be associated with obesity, sleep, postural and visual disturbances, and cognitive disturbances amongst others.⁴

The childhood vaccine delivery system was also disrupted during the pandemic resulting in an additional rise of 1.4 million incompletely vaccinated children in 2020 as compared to 2019. The pandemic has also affected routine healthcare checkup and diagnosis of chronic illnesses in children and also health of children with attention-deficit hyperactivity disorder, autism spectrum disorders and children with special needs and their caregivers.⁴ Thus, there is an urgent need to restore these services at the earliest to prevent long term complications.

A recent study of about 23000 children showed that nearly 4 out of 5 children had a negative psychological effect like anxiety, depression, irritability and inattention, due to the pandemic and its consequent restrictions.⁴

Studies suggest prenatal stress affects fetal development. Increase in maternal mental disorders like anxiety (ranging from 21.7-78.4%), depression (ranging from 17-56.3%) and post-traumatic stress disorder during pandemic period in pregnant female due to range of reason starting from fear of transmission of infection to child to spousal relationship tension.⁵ These symptoms of maternal mental disorders have been linked with delays and poor infant motor, social, cognitive, and language development and difficulties in emotional self-regulation.⁶

Objectives

This was a systematic review that examined the impact of COVID-19 pandemic on child growth and development.

METHOD

Study period

June 2022 to December 2022

Search strategy

Keywords (including all commonly used abbreviations of these terms) used in the search strategy were as follows: "SARS-CoV-2" or "CoV2" or "COVID-19" and

"Pandemic" and "Child Development" and "Adolescents".

Data extraction (selecting and coding)

The guidelines from the preferred reporting items for systematic reviews were used to conduct this review of the scientific literature about the impact of COVID-19 pandemic on child development.

For literature search, we went through papers published in PubMed, Europe PMC, Google Scholar and Science Direct on COVID-19 pandemic and its effects on Child and Adolescent Development. After the initial search, the authors removed articles that were duplicated and included all eligible studies. Studies were included strictly on the basis of inclusion criteria. Primary screening was done by reading the abstract part and if any queries were raised then the authors went through the whole article. After a primary review, the authors went through the full-text article for final inclusion of the study in systematic review. Data included in the study was 7 articles. After the data was extracted, it was cross checked for quality assessment. The studies where completed data was not available and those which were not peer-reviewed were excluded. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) criteria were applied

Following eligibility criteria was applied to review and screen the articles.

Inclusion criteria

Articles in English, articles with study population as children were included in the study.

Exclusion criteria

Articles whose full text couldn't be obtained; journals not accessible online were excluded from study.

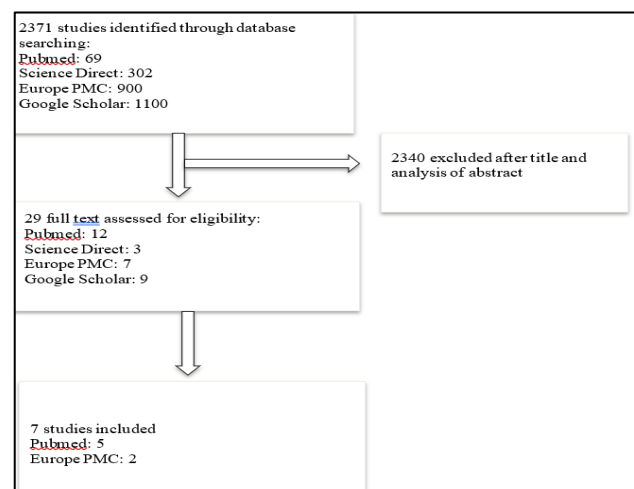


Figure 1: Flow chart for data collection.

Risk of bias (quality) assessment

Standard quality assessment tools used: Case reports/case series: Joanna Briggs institute checklist, observational studies: CASP (Critical appraisal skills programme), systematic review/meta-analysis: AMSTAR checklist. Studies were ranked as good, fair and poor quality based on assessment scores of respective studies.

Strategy for data synthesis

For statistical analysis, we used Microsoft excel 2013

data analysis Toolpack. Based on distribution of values, continuous data expressed as the mean $\pm$ standard deviation.

RESULTS

After thorough analysis of the literature available on PubMed, Europe PMC, Google Scholar as well as the removing the studies following the exclusion criteria, total of seven studies were included in this review out of which the three are systematic reviews, shown in the Table 1.

Table 1: Summary of the studies included in this review.

Author	Country	Study type	Critical appraisal	Objective	Methods
De Araújo et al¹	NA	Systematic review	5/10 Moderate AMSTAR	Examine the impact of epidemics or social restriction on mental and developmental health in parents and children/adolescents.	Analysis of previous articles and research
De Laia Almeida et al²	NA	Systematic review	6/10 Moderate AMSTAR	Analyze the effects of social isolation on children's and teenagers' development, with emphasis on possible impacts over their physical and mental health.	Analysis of previous articles and research
Kokkinaki et al⁵	NA	Narrative review	N/A	Discuss possible factors that may have affected negatively perinatal mental health through pandemic-related restrictions	Analysis of previous articles and research
Diego et al⁶	United States	Cross sectional	8/10 High CASP	To identify whether prenatal depression is a risk factor for fetal growth restriction.	Midgestation estimated data collected on a sample of 40 depressed and 40 non-depressed women and then data used to compute fetal growth rate
Oliva-Arnanz et al⁹	Spain	Descriptive study	6/10 Moderate CASP	Assess families' perceptions of the motor development and quality of life of their children aged 0-3 years during home confinement due to the COVID-19 pandemic	Data collection of the variables "motor development and quality of life" was carried out with a simple online questionnaire
Pombo et al¹⁰	Portugal	Intervention and follow-up study	6/10 moderate CASP	Assess the effects of the COVID-19 lockdown on Portuguese children's motor competence	Motor competency was evaluated with a valid quantitative instrument, the motor competence assessment (MCA) developed by Luz and colleagues
Pajek¹¹	Slovenia	Prospective observational study	6/10 Moderate CASP	To determine the impact of the COVID-19 pandemic on physical fitness and motor development of primary school children.	Data on population density taken from publicly available SiStat database of statistical office of Republic of Slovenia

De Araújo et al conducted a review of studies to examine the impact of epidemics or social restriction on mental and developmental health in parents and children/adolescents.¹ The study concluded that the COVID-19 pandemic has resulted in significant rates of sickness and mortality among the world's population as well as risk factors for children's healthy growth and development. Some of the variables mentioned in the research include an increase in parental stress, the suspension of classroom activities, social isolation measures, dietary concerns, children's exposure to toxic stress, especially in previously unstructured families, and a lack of physical activity.

Another systematic review was conducted by De Laia Almeida et al on the effects of social isolation on children's and teenagers' development, with emphasis on the possible impacts over their physical and mental health.² According to the analysis, social isolation is strongly linked to anxiety and depression in kids and teenagers. Cortisol levels rise and cognitive development is negatively impacted by social isolation. Therefore, during and after the COVID-19 pandemic, health practitioners need to closely monitor the mental and physical health of children and adolescents.

Kokkinaki et al carried out a review of literature to discuss possible factors that may have negatively affected perinatal mental health through the pandemic-related restrictions.⁵ The study implied that National policies and evidence-based interventions are required due to the pandemic condition's negative effects on maternal wellbeing and baby development. In an effort to support healthy new family development and postpartum care, these interventions must be integrated into the healthcare system. The "new normal" of the present requires that interventions to improve prenatal mother mental health be modified. Priority areas for inclusion in COVID-19-related policy guidelines should be maternal wellness and how it affects baby development.

A cross-sectional study assessed whether prenatal depression is a risk factor for fetal growth restriction. The results show that depressed women had a 13% greater incidence of premature delivery and 15% greater incidence of low birthweight than non-depressed women. Depressed women also had elevated prenatal cortisol levels and fetuses who were smaller and who showed slower fetal growth rates and lower birth weights. Furthermore, mediation studies showed that maternal cortisol levels during pregnancy were a potential mediator for the association between maternal depressive symptoms and both gestational age at birth and the pace of fetal growth.

Oliva-Arnanz et al described the families' perceptions of the motor development and quality of life of their children during home confinement due to the COVID-19 pandemic.⁹ The study showed that no low values were found in the assessment of motor development and

quality of life in children (0-3 years old) after being kept at home due to the COVID-19 pandemic, therefore it is unlikely to be impacted during this time of reduced exposure to the outdoors. It should be noted that the emotional component of quality of life scored the lowest, which suggests that young children (0-3) who are kept at home need more emotional assistance in conditions of routine and family stress.

In another study, data was obtained from 114 children (50 boys and 64 girls; mean age of 7 years old) to assess the effects of the COVID-19 lockdown on Portuguese children's motor competence. The results indicate that, regardless of sex, motor performances after lockdown in five of the six tests were lower than before lockdown. Children's performance, assessed by a standardized MC test, the MCA, was significantly lower after the lockdown in all motor tests, in the three components of MC, and in global MC, with most children shifting from an upper to a lower quartile between the pre- and post-lockdown periods. The COVID-19 epidemic has disturbed many elements of this generation's lives, including PA and sedentary behaviors, screen time, dietary habits, and even motor development, however the long-term effects of this time are still unknown.

Pajek conducted a study to determine the impact of the COVID-19 pandemic on physical fitness and motor development of primary school children.¹¹ The research showed that the COVID-19 pandemic had a severe impact on schoolchildren's motor development, with significant impairments in the areas of cardiorespiratory endurance (600 m run), skill-related fitness (polygon course backwards, 60 m run), and core strength (sit-ups). In general, rural communities felt the pandemic's consequences more severely. Teachers of physical education and coaches in sports organizations will benefit from our findings as they develop physical activity programmes for kids.

DISCUSSION

Emergence of COVID-19 pandemic

SARS-CoV-2 whose first case was reported in Wuhan, Hubei Province, China, in late December 2019, emerged as an acute respiratory infectious disease which is mainly transmitted through the respiratory tract.⁷ Its rapid dissemination compelled the world health organization (WHO) to declare it as a global pandemic on March 11, 2020.⁸

Mortality and morbidity among children due to COVID-19 infection

Among the 4.4 million COVID-19 deaths reported in the MPIDR COVerAGE database, 0.4% (over 17,200) occurred in children and adolescents under 20 years of age. Of the over 17,200 deaths reported in those under 20

years of age, 53% occurred among adolescents ages 10-19, and 47% among children ages 0-9. (UNICEF)

Vaccination drive for children around the world

As of today (26 July 2022), according to CDC children get a smaller dose of COVID-19 vaccine than teens and adults that is the right amount for their age group. Most countries allow vaccination for children and adolescents aged 16-18 years, and several also approve vaccinations for children younger than 16 years.

The total number of person-days at risk was 5,118,468 in the unvaccinated group, 5,340,205 in the partially vaccinated group, and 7,405,066 in the fully vaccinated group

After adjustment for covariates including the calendar date during the study period (given the changing community transmission rates over time), vaccine effectiveness against all reported infections, PCR-confirmed infections, and hospitalizations in partially vaccinated as compared with unvaccinated children was 13.6% (95% CI, 11.7 to 15.5), 24.3% (95% CI, 19.5 to 28.9), and 42.3% (95% CI, 24.9 to 55.7), respectively. In fully vaccinated children, we estimated vaccine effectiveness to be 36.8% (95% CI, 35.3 to 38.2) against all reported infections, 65.3% (95% CI, 62.0 to 68.3) against PCR-confirmed infections, and 82.7% (95% CI, 74.8 to 88.2) against hospitalization.

Psychological impact of lockdown on child growth and development

Various studies have confirmed negative correlations between depressive symptoms and family cohesion/adaptability. Basic health services worldwide have been heterogeneously affected by the COVID-19 pandemic. There is a variation in strategies adopted to maintain continuity of maternal health services as a response to COVID-19 crisis, limits have been placed on antenatal classes' attendance by pregnant women, decrease of presentations of obstetric-related conditions to the emergency departments, restrictions on health care tests and treatments availability, in both ante- and postnatal care while companionship for birth and postnatal visiting have been prohibited. Giving birth in hospitals full of SARS-CoV-2 infected patients increase further maternal worries for the possibility of their and their infants' infection with adverse physical and psychological implications for both of them. Expectant mothers' reluctance to attend and delay in seeking treatment, due to the fear of being exposed to the virus, may result in poorer outcomes. Moreover, in cases of maternal SARS-CoV-2 infection, forced separation of mothers and infants for up to 14 days has been reported. This prohibited immediate and uninterrupted skin-to-skin contact. These restrictions have a negative effect on mother's mood, self-esteem, self-confidence and confidence in their abilities related to their infant's care.

pregnant psychological wellbeing, personal history of maternal mental illness, pregnancy complications, fear of childbirth, support and relationship with the partner, fear of health, the first moments with the baby/mother-infant bond (skin-to-skin contact, breastfeeding), previous birth experiences, perceived control, birth plan compliance and medical-obstetric dimensions. An online survey, mainly in European countries, showed an acute decrease in sleep quality (which plays a crucial role in brain maturation) in 0-35-month-old infants and 36-71-month preschool children in April 2020. early structures of the developing limbic system (e.g., amygdala and hippocampus) may also be influenced by the maternal stress it is critical that the development of fetal systems [ANS, HPA development and brain structures of the limbic system (amygdala and the hippocampus)] that have been reported to be affected by maternal prenatal stress are also potentially related factors and causes of neuropsychiatric disorders [depression, anxiety, behavioral dysfunction, attention-deficit hyperactivity disorder (ADHD), autism spectrum disorder] in children. Prenatal depression was associated with adverse perinatal outcomes, including premature delivery and slower fetal growth rates. Prenatal maternal cortisol levels appear to play a role in mediating these outcomes.

How has economic insecurity affected child growth development

The systematic review by Lachman et al. makes intervention recommendations, provides statistical information on underdeveloped economies and inadequate investment in nations like Nigeria and Namibia, as well as information on the plight of refugees and the psychological effects of war (10-20% of children exposed to war are susceptible to psychiatric disorders).¹

A study showed that due to the protracted lockdown's impact on the economy, food shortages and an increase in food prices resulted. This made it difficult for many families to give their kids the nutrients they require for healthy physical and mental growth. Children may be affected by this for the rest of their lives. As of 2019, 14 million children under the age of five had severe wasting, while 114 million children under the age of five were stunted. Without prompt action, there were 14.3% more wasted children during the first year of the epidemic, totaling 6.7 million more wasted children under the age of five, which resulted in an additional 10,000 child fatalities each month during the same time period.¹²

Impact of unavailability of healthcare services on children during pandemic

The already overburdened healthcare system changed its focus to emphasize the COVID-19 response, which could lead to an increase in other childhood illnesses and outbreaks. According to a global survey, people had to overcome significant obstacles to receive healthcare services during the pandemic, including healthcare

facility closures (10%), lengthy wait times at facilities that prevented patients from receiving assessments or treatment (12%), and a shortage of necessary medications at pharmacies and healthcare facilities (15%). Quarantine and isolation policies implemented at homes, facilities, or in specific geographic areas may make it difficult for kids and their families to access high-quality medical care. Concerns about potential delays in obtaining healthcare treatments with higher rates of morbidity and death have been raised as a result of a significant decrease in paediatric emergency care utilization.¹²

Miscellaneous

The environment provides several opportunities for interaction, which has an impact on how the youngster develops their motor skills. The children's environment is vital for their development and creation of new skills since the activity that is done and the context in which it is done determine whether or not new motor skills are acquired. In one study, it was found that children with an age range of 2-3 years earned better scores in motor development than children with an age range of 0-1 and 1-2 years, providing evidence for this interaction with the natural world. This may imply that before being confined to the home, toddlers between the ages of 2-3 had more opportunity to interact with their surroundings, learn new abilities, and advance their motor development at a more complex level while acquiring more communication structures.⁹

Another study demonstrated the lockdown's detrimental effects on kids' MC in a way that can be scientifically measured. In all motor tasks (aside from jumping sideways), in all three MC components, and in global MC (an average of 13 points in boys and 16 points in girls), children's performance, as measured by a standardized MC test, the MCA, was significantly lower after the lockdown, with the majority of kids moving from an upper to a lower quartile between the pre- and post-lockdown periods.¹⁰

Another research showed that the COVID-19 pandemic had a severe impact on schoolchildren's motor development, with significant impairments in the areas of cardiorespiratory endurance (600 m run), skill-related fitness (polygon course backwards, 60 m run), and core strength (sit-ups).¹¹

CONCLUSION

The impact of the COVID-19 pandemic on child development is a complex and evolving area of research, with many different factors at play. While some studies have suggested that the pandemic has had negative effects on children's physical and mental health, academic performance, and social development, other research has highlighted the resilience of children and the ways in which they have adapted to the challenges of the pandemic. Overall, it appears that the pandemic has had a

significant impact on many aspects of children's lives, particularly for those from disadvantaged backgrounds or with pre-existing vulnerabilities. However, the long-term effects of these disruptions remain uncertain and will likely continue to be the subject of ongoing research and debate. It is important to note that the impact of the pandemic on child development may also vary depending on a range of individual, family, and community factors. As such, it is essential to consider the unique circumstances of each child and family when assessing the effect of the pandemic and developing interventions and support programs to address any negative impacts.

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