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Review Article

Relation between ADHD and COVID-19: A Narrative Review to Guide Advancing Clinical Research and Therapy

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Abstract

Objective: To cope with the COVID-19 pandemic, national health authorities temporarily closed cultural, religious, and educational institutions such as universities and schools. Children and adolescents with ADHD were challenged with the restrictions caused by the Covid-19 pandemic such as homeschooling and reduced physical activity. The present narrative review aimed to summarize the state-of-the-art regarding associations between COVID-19-related social restrictions and possible psychological and behavioral issues in children and adolescents with ADHD. Additionally, we discussed the underlying possible reasons of the association focusing on the role of parental influence and physical activity, vulnerabilities of individuals with ADHD to Covid-19 infection and to school closure and remote learning.
Method: To collect data for the present narrative review, recent publications on these topics between February 1st, 2020 and January 10th, 2021 were retrieved from the most popular search engines (PubMed; Scopus; Google Scholar; Psych Info; Embase) through a comprehensive search using relevant keywords.
Results: During confinement, children and adolescents with ADHD reported increased behavioral and ADHD-related symptoms and overall decreased psychological well-being. Factors negatively impacting children's and adolescents' behavioral symptoms and well-being were: less physical activity, adverse parental behavior, difficulties in coping with preventive guidelines, and school closure and remote learning consequences.
Conclusion: Children and adolescents with ADHD and their caregivers faced both specific and general psychological issues related to the school lockdowns and homeschooling. Additionally, Individuals with ADHD seem to be more vulnerable to Covid-19 infection which highlights the need for better healthcare adaptation.

Key words: *Attention Deficit Disorder with Hyperactivity; COVID-19; Mental Health; Psychiatry; Review*

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The coronavirus disease 2019 (COVID-19) and it becoming a pandemic has brought numerous challenges for societies, individuals, and healthcare systems. To decrease the risk of the virus spreading and further deaths and severe cases of infection, health care authorities imposed confinements (1). To this end, health authorities temporarily legislated to close borders, schools, universities, cultural and sports events, and to prevent gatherings in open spaces. Although these preventive measures could restrict virus transmission, there was concern that such actions might negatively affect physical and mental health of individuals (2, 3).

Restrictions related to confinements might impact a person's mental well-being. This holds even more true for children and adolescents with psychiatric disorders such as attention-deficit/hyperactivity disorder (ADHD) (4). Furthermore, compared to children and adolescents in non-quarantine situations, children and adolescents in quarantine reported higher self-rated scores of psychological distress such as worry, helplessness, and fear (5). Concurrently, individuals with mental disorders may be at greater risk for COVID-19 infection compared to healthy individuals (6, 7). This may stem from difficulties in adhering to quarantine rules, not following healthcare instructions pertaining to COVID-19, homelessness, limitations in access to healthcare, or living in places with higher exposure to the contagion (8).

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common disorders among children and adolescents (9). It is estimated that about 5-7% of children worldwide are diagnosed with ADHD, and the prevalence of ADHD in Tehran, the capital city of Iran, was reported to be about 8.6% (10). Commonly, ADHD co-occurs with impaired academic, social, and/or occupational functioning, aggression, learning disabilities, high risk taking, inattentiveness, depression, disobedience, low self-esteem, and emotional and cognitive problems (11). ADHD is primarily known as a childhood disorder; however, about 50% of children with ADHD continue to have the symptoms into adolescence, and 30-60% of these continue having symptoms as adults (12, 13). Notably, it was previously reported that the symptoms of ADHD might worsen throughout the COVID-19 pandemic (14, 15). This can put children and adolescents with ADHD at risk for COVID-19 infection (7).

However, at present, there appears to be a lack of narrative reviews to demonstrate the COVID-19 pandemic impact on individuals with ADHD and the vulnerability of these individuals to the consequences of this pandemic. The consequences of the pandemic on ADHD appears to be still controversial (16). Thus, clinicians might benefit from recommendations such as improving everyday life for individuals with ADHD during the Covid-19-related confinement. In the present narrative review, we aimed at highlighting and summarizing the most recent knowledge and findings on associations between COVID-19-related restrictions and the psychological well-being of children and adolescents with ADHD. The following topics were reported: a) impact of Covid-19 pandemic on ADHD symptoms, including impact on physical activity and parental influence; b) vulnerabilities of individuals with ADHD to Covid-19 infection and c) vulnerabilities of individuals with ADHD to consequences of school closure and remote learning.

Materials and Methods

We note that by default, it was impossible to review and retrieve all relevant and rapidly growing literature on the topic.

First, we searched for papers in the Google Scholar database using the term "Covid-19 and ADHD" and "Covid-19 and Attention deficit hyperactivity disorder" published between February 1st, 2020 and January 10th, 2021. To make sure our search strategy yielded efficient results, we searched Google Scholar using the term "mental health and Covid-19". Then, we went through articles and selected those focusing more specifically to the topic. Next, we applied the same search strategy in other more popular databases (PubMed, Embase, PsychInfo, and Scopus) and retrieved papers which were not selected in the first phase. Using this strategy, 28 papers focusing on the relation between Covid-19-related consequences and ADHD in children and adolescents were selected. The search focused on all types of recent articles and guidelines published between February 1st, 2020 and January 10th, 2021. We specially focused on publications which assessed the psychological impact of Covid-19 pandemic and its related restrictions on children and adolescents with ADHD.

Results

1. Impact of Covid-19 on ADHD symptoms and related problems in children and adolescents with ADHD

Compared to the time lapse before confinement, children and adolescents reported to have much less contact with their friends, peers and teachers (17). ADHD-related symptoms such as conduct and prosocial behaviors, behavioral symptoms, and emotional difficulties worsened during confinement (18). To illustrate, Zhang *et al.* (19, 20) conducted a cross-sectional study to investigate mental health related conditions of children with ADHD during the Covid-19 outbreak. The authors hypothesized that children's ADHD symptoms might have accentuated since start of the Covid-19 pandemic. To this end, Zhang *et al.* recruited 241 school aged children (194 boys and 47 girls) between 6-15 years old (M=9.4, SD=2.39). To assess children's ADHD-related behavior during the Covid-19 pandemic, parents completed the Swanson, Nolan, and Pelham scale (SNAP-IV) – parent form (21). 54% of parents reported that their children had more difficulties with attention;

56% of parents reported that their children had more issues with daily routines, and 67% of parents reported that their children had more difficulties with coping with anger. The authors also found that increased ADHD symptoms were associated with higher negative mood.

Additionally, Bobo *et al*. (14) conducted an epidemiological study to assess global life conditions and general well-being of children and adolescents with ADHD during the Covid-19 confinement. Utilizing social media, the authors surveyed 538 parents of individuals with ADHD between day 20 and 30 of lockdown in France. Most of the responders were mothers and the mean age for their children was 10.5 years. Based on parental reports, about 34% of children experienced deterioration in their well-being, in 34% of children well-being remained unchanged, and in 31% of children well-being improved. Attention in children with ADHD improved. Parents associated improvement in attention with being in a familiar environment conducive to work. Additionally, some parents observed decreases in agitation symptoms and associated this improvement with the relaxation of time-constraints (such as those imposed by school, rehabilitation, and follow-up appointments). Furthermore, increased opposition or aggression during confinement was also reported by parents and described as part of sleep and emotional disturbance such as more frequent violence. To summarize, the result of this survey did not suggest a significant worsening of ADHD symptoms during the Covid-19 confinement (14). However, this evidence was descriptive and anecdotal, and, therefore, there is no potential for bias.

Furthermore, results of the study conducted by Shah *et al.* (22) showed that the Covid-19 lockdown negatively impacted symptoms in children with ADHD. Using an online questionnaire, the authors aimed to explore how Covid-19 lockdown had changed behavior of children with ADHD and their parents and how it had impacted severity of ADHD. Items of the questionnaire assessing severity of ADHD were taken from the Vanderbilt ADHD parent rating scale (20). Among the 48 participants who filled out the initial survey, 47.9% were fathers, 45.8% were mothers, and 6.3% were other relatives of children with ADHD. The mean age of children with ADHD was reported to be 9.79 with gender mainly being male. Based on the results of the survey, irritability/tantrum was markedly increased in 11 children and slightly increased in 11 children with ADHD. Additionally, disruptive/disturbing behavior was markedly increased in 6 and slightly increased in 17 children with ADHD. Feelings such as boredom, anxiety, and demand for more time from parents were also increased to about 35%, 30% and 36%, respectively. Based on the results taken from the Vanderbilt ADHD severity scale, ADHD symptoms such as inattention, hyperactivity, and oppositional defiance problems were mainly reported often/very often by parents or relatives during the last one month.

This study demonstrated that the Covid-19 lockdown was associated with worsened ADHD symptoms in a major proportion of Children with ADHD and improved behavioral/academic functioning in a few children. Moreover, the results of a more recent study using online surveys by Melegari *et al.* (4) on 992 parents of individuals with ADHD aimed to explore severity degree of disruptive behaviors (i.e., opposition, verbal and physical aggression, restlessness, argument) and mood/emotional state (i.e., irritability, sadness, anxiety, boredom, little enjoyment/interest, temper tantrums) based on their frequency before and during the Covid-19 lockdown. The authors found significant inconsistencies in all dimensions. During the lockdown, in children with highly severe ADHD, all explored dimensions were elevated in frequency except opposition and restlessness, whereas in adolescents with highly severe ADHD, elevated percentages were observed only in these dimensions: little enjoyment/interest, boredom, temper tantrums, and argument. Understanding of the mentioned worsening and the different patterns of change between children and adolescents require further research. In general, the study suggested that individuals with ADHD with high and moderate severity degree were more stable in their severity degree compared to individuals with low severity degree of symptoms. Interestingly, subjects with moderate and severe symptoms showed improvement during the Covid-19 lockdown. The highest scale of alteration and significant worsening in around all dimension were reported in individuals with low severity degree before and during the Covid-19 lockdown. This study also confirmed that children were more vulnerable to mood fluctuations compared with adolescents and suggested further research to understand this general worsening with focus on unraveling association with acute stress symptoms, management strategies of the situation by parents, and comorbidity profile of the individuals with ADHD independently by age and mental health. To this end, attention to this vulnerable group in various efficient forms (e.g. "text-message"-based intervention) was highly suggested to help them overcome the challenges and lessen the distress during the ongoing Covid-19 pandemic.

It was previously known that sleep disorders are common in ADHD and can leave dire impacts on neurobehavioral functions (e.g., memory, emotion regulation, and learning) (23). In this regard, one single-center cross-sectional study evaluated the relationship between chronotype preference/sleep problems and severity of symptoms in children with ADHD during the Covid-19 outbreak. The authors surveyed 76 children with ADHD aging 8-12 years and their parents using Children's Sleep Habits Questionnaire (CSHQ) and Children's Chronotype Questionnaire (CCQ) during the 5th week after lockdown. The findings showed that individuals preferring evening time ("E chronotype") were more prevalent and had more sleep disturbance in comparison with the control group. The E-type group

also exhibited more severe ADHD symptoms compared to the non-E type group since the COVID-19 outbreak. The results indicated that good quantity and quality of sleep in children and adolescents with ADHD can mitigate ADHD symptoms (24). Additionally, Sciberras *et al.* (15) found that children with ADHD experienced increased sleep problems during the Covid-19 pandemic. Worthy of note is that less outdoor activities and fewer opportunities to exercise may have a role in worsening of sleep problems (25). Parents of children with ADHD have a significant role in supervising and regulating the sleep pattern of their children, and their proper management can positively change behavior, social function, and emotion of their children (26). Thus, the authors believe that conscious measures should be taken to train and raise awareness in parents of children with ADHD on sleep problems which their children might face during the Covid-19 pandemic and the significant role of parents in overcoming the issue.

Impact of physical activity on ADHD symptoms during the Covid-19 pandemic

Sport therapy seems to be helpful in behavioral management of children with ADHD especially in improving attention, social and cognitive functions (27-29). One study revealed that the effect of guided walk in the park on attention spans appeared to be approximately equivalent to the effect of two doses of typical ADHD medication (30). Based on parental reports, Sciberras *et al.* (15) demonstrated that children with ADHD had less exercise, less outdoor time, less enjoyment in outdoor activities, higher gaming, and higher social media use when Covid-19 restrictions were in place compared to pre-pandemic situations. Interestingly, the result of the internet based survey on 1264 primary school students between February 25 and March 8, 2020 in China presented that children with physical activity had lower risk for hyperactivity and inattention compared to children who did not exercise (31).

The current restrictions including school closures and abstaining from outdoor activities have made children with ADHD less physically active than ever with more time spent with television, social media, and gaming (15). The available literature suggests that exercise might be beneficial in lowering behavioral symptoms of school-aged children during the Covid-19 pandemic (31). Thus, if special attention and necessary measures are paid by parents and caregivers to this issue, individuals with ADHD might show better performance in social, occupational, and academic performance during the Covid-19 pandemic.

Impact of parental influence on ADHD symptoms during the Covid-19 pandemic

Appropriate parental care and meeting children's medical and nutritional needs can have long-term neuropsychiatric effects on children including those with ADHD (32). During the Covid-19 pandemic, parents of children with ADHD were challenged with simultaneous home-schooling and behavioral management of their children, working from home, and lack of external social support (17). Meanwhile, parents themselves were also challenged with psychological and emotional distress caused by Covid-19 pandemic consequences such as wage reduction, job loss, and having sick or dead relatives (33, 34). Recent research by Morelli *et al*. (33) suggested that parents' belief regarding being a capable parental task manager during Covid-19 pandemic could support their children's emotional well-being. Another research conducted by Spinelli *et al.* (35) showed that parental stress on the Covid-19 pandemic and lock down had exacerbated their children's emotional, psychological, and behavioral problems. Acknowledging all these factors, concerns discussed above may lead to psychological problems and violence in parents and children (17).

Additionally, Cortese *et al.* (36) suggested that confinement of families in their homes could have led to coercive behavior on behalf of parents and children. Based on an online survey from parents of children with ADHD during the Covid-19 pandemic, the authors reported increases in irritability (37.5%), shouting at children (43.8%), verbal abuse (25%), and punishment (27.1%) in behavior of family members. Importantly, an overall worsening of ADHD symptoms in irritability (45.8%), disruptive/disturbing behavior (47.7%), and activity (50.1%) of children with ADHD was reported (22). The results of the study conducted by Melegari *et al.* (4) presented that the Covid-19 confinement could exacerbate family environment conflicts. However, the results of the study by Shah *et al.* (22) on 48 children with ADHD did not present exacerbated family environment during the Covid-19 lockdown. In 20 children with ADHD, their relationship with parents and in 13 children with ADHD, their relationship with siblings were improved. Nevertheless, there was increased verbal abuse, hitting, punishing, and shouting at child from the parental side. Although the findings suggested overall worsened ADHD symptoms, the authors did not suggest that the worsened symptoms were directly associated with the family environment. Consistently, a survey on 241 parents of school-aged children with ADHD in China during the Covid-19 pandemic showed that parents' moods were correlated with children's moods and children's study time (19). Notably, another study conducted by Marchetti *et al.* (37) on 878 Italian parents with mothers' mean age mostly being 40.58 years, it was postulated that parental distress was significantly associated with children's hyperactivity/inattention, and children's emotional behavior and parent verbal hostility could positively mediate the association. These might suggest a bi-directional association between parental behavior and their children's aggravation of ADHD symptoms, and we suggest further research to understand the proper parental functioning of children with ADHD during the Covid-19 pandemic. Finally, it should be noted that although parental involvement in home schooling

depends on many factors such as gender of the children and parental beliefs, but school psychologists can help parents in organizing and improving the children's daily structure by implementing particular strategies such as incorporating physical activity into daily routines (38).

2. Vulnerabilities of children and adolescents with ADHD to Covid-19 infection

Untreated individuals with ADHD seem to be more vulnerable to COVID-19 infection compared to individuals with ADHD who receive proper medication regularly (7). Merzon *et al.* (7) conducted a study on 14022 subjects registered with the Leumit Health Services between February 1st and April 30, 2020 to assess whether ADHD establishes a risk factor for Covid-19 infection and whether proper pharmacotherpay can ameloriate the risk. Based on the subjects' previous Covid-19 test, 1416 subjects tested positive. The Covid-19 positive subjects had higher rates for ADHD compared to Covid-19 negative subjects. Notably, children and adolescents with ADHD who were taking ADHD-specific medications regularly (e.g., Methylphenidate or Atomoxetine at therapeutic dosages) showed no additional risk for Covid-19 infection compared to subjects with no ADHD, but the risk for Covid-19 infection dramatically increased in individuals with untreated ADHD (7). The authors postulated that ADHD could be a risk factor for COVID-19 infection and the appropriate ADHD-related pharmacotherapy may ameliorate the risk of infection. Thus, it can be assumed that individuals with ADHD who were treated adequately with an appropriate ADHD-related pharmacotherapy had better outcomes and fewer challenges during this pandemic compared to individuals with untreated ADHD.

Greater risk for COVID-19 infection in individuals with ADHD can be attributed to inattentiveness, hyperactivity, and impulsive behaviors. For instance, inattentiveness decreases the prospects of individuals with ADHD wearing face masks, using detergents, washing their hands, abstaining from outdoor activities, and complying with social distancing (6). Additionally, Pollak *et al.* (39) suggested that high levels of ADHD symptoms could be identified as a predictor of non-adherence to public health instructions during the Covid-19 pandemic. This may be as a result of the greater tendency of these individuals to participate in risky behaviors. The aforementioned behavioral patterns may make it harder for these individuals to adhere to World Health Organization (WHO) prevention protocols and to understand the complexity of the situation, making them more vulnerable to COVID-19 infection (4, 7). Notably, and against expectations, individuals with ADHD who are infected with COVID-19 might show higher recovery rates from Covid-19 infection. This can result from an evolutionary advantage of ADHD and their higher creativity levels in problem solving (40, 41). However, further research is needed to assess this observation and to further define whether and how evolutionary advantages of ADHD may improve recovery rates.

3. Vulnerability of children and adolescents with ADHD to consequences of school closure and remote learning

Schools do not merely serve educational purposes, but rather they are often considered a "second home" that promotes social-emotional development. Moreover, schools and institutions teach their students to maintain personal hygiene, keep a balanced diet, and stay physically active. Hence, loss of daily school structure influences students both physically and mentally (25, 32).

Individuals with ADHD face various difficulties in concentration, time management, prioritizing, and organization of daily tasks due to their impaired self-regulation and self-motivation, leaving dire effects on their education, employment, and interpersonal relationships (13). Moreover, learning disabilities are very common among individuals with ADHD (42), and it can be expected that homeschooling might have deleterious effects on individuals with ADHD in various ways. To illustrate, the result of school closure has been a shift to online classes and digital solutions. While in many cases the shift has been embraced by students, teachers, and parents, this type of education has been challenging for individuals with ADHD (38). This is in line with the finding by Zhang *et al.* (19) where about 56% of interviewed parents of children with ADHD reported worsening of daily routines following confinement restrictions and the shift to online schooling. Zhang *et al.* also observed that with an increased amount of study time, symptoms of ADHD were not exacerbated, and children who could use online study better, might find long concentration easier. Further research conducted by Melegari *et al.* (4) was consistent with the previous statement. Consistently, Becker *et al.* (43) reported that children with ADHD found remote education more difficult than regular schooling. Specifically, students with ADHD receiving academic accommodations were increasingly affected by this, with 31% of parents feeling unprepared to provide adequate academic support to their children at home. Moreover, unavailability or insufficiency of additional support with homeschooling may exacerbate academic performance of individuals with ADHD (44), and available data suggests that poor academic performance can increase risk of depression in individuals with ADHD (45).

While school closure and remote learning have been challenging for children with ADHD and their parents, remote learning may eliminate school-related stressors that children with ADHD regularly experience including social difficulty and poor academic achievement (14, 15) In this regard, parents of individuals with mental health problems stated that homeschooling has had overall negative effects on their children ; however , they also reported positive effects of homeschooling on their

children's wellbeing (44). For instance, the results of the study on 48 children with ADHD showed that more than 33% of children improved their academic performance in mathematics, reading, and writing (22). Thorell *et al.* (44) state that the positive effects of homeschooling on children with mental health problems in general or neurodevelopmental disorders, specifically [i.e., ADHD or Autism Spectrum Disorders (ASD)], may be caused by reduced exam pressure, less anxiety as a result of reduced contact with peers, and more flexible timeline for managing school work.

Finally, previous studies indicate that teachers lack sufficient knowledge and attitude about ADHD and have several misconceptions toward the disorder. Proper attitude and measures by teachers (e.g. encouragement and tolerance) can help minimize cognitive dysfunctions of children with ADHD (11). Additionally, teachers take on an important role in initial ADHD diagnosis and monitoring of the condition, but regular ADHD intervention programs which exist in schools have not been adapted to online settings yet (43). In this regard, proper attitude and awareness of teachers toward ADHD and the difficulties individuals with ADHD are facing in the era of Covid-19 pandemic is strongly recommended.

Limitation

Compared to systematic reviews, narrative reviews may bear the risk of missing the whole range of possible topics. For instance, our search strategy and exclusion/inclusion criteria were defined in a broader fashion, compared to the exclusion/inclusion criteria of systematic reviews. Similarly, the time lapse to search for suitable papers was ended in mid-January 2021. However, almost by definition, it seems rather impossible to retrieve and review all of the relevant and rapidly growing literature on the topic. Nevertheless, the results of this narrative review provide a thoroughly elaborated overview of the impact of COVID-19-related restrictions on children and adolescents with ADHD along with its management to provide helpful information for families and clinicians to cope with the situation in a more efficient and satisfying fashion.

Conclusion

In conclusion, children and adolescents with ADHD may face worsening symptoms and challenges during the COVID-19 pandemic. An increase in ADHD symptoms and a decline in general well-being in these individuals have been observed during the Covid-19 pandemic. This is largely due to school closures, drastic changes in routine, parental influence, and decrease in physical activity. Contributing stress factors such as parental behavior, parental absence, harder access to ADHD medication, financial hardships, and domestic abuse in family settings should not be overlooked. By contrast, parents' resources may also have a stress-buffering effect on their children's symptomatology and behavior. Promising attempts have been made by means of telemedicine and telepsychiatry in parental behavior training as well as provision of care to children and adolescents with ADHD. Thus, a combination of digital health adaptations, physical exercise, and behavioral training of families may provide for adequate management of ADHD during the pandemic. However, further research will be needed to identify targeted approaches for symptom management and amelioration in individuals with ADHD as the COVID-19 pandemic carries on.

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Conflict of Interest

None.

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