Sleep in Children with Neurodevelopmental Disabilities during COVID-19:

An Integrative Review

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Introduction  

A notable outbreak of the coronavirus (COVID-19) rapidly spread throughout many countries in December 2019, in the ensuing months stay-at-home orders were issued to contain the virus. These lockdown orders persisted for several weeks to months causing a complete disruption of daily routines in the general population due to work from home, home-schooling, and reduced levels of physical activity and social gatherings (Cheng et al., 2020). During the COVID-19 restrictions, only 4.8% of children and 0.6% of youth met recommended activity guidelines whereas leisure screen time and social media use were reported as much higher than before the COVID-19 lockdowns (Moore et al., 2020). 

Children with neurodevelopmental disorders (NDD) such as autism spectrum disorder (ASD) commonly have difficulties in behavior, communication, and sensory integration (Masi et al., 2017), have high vulnerability to lifestyle changes (Barkley & Fischer, 2011), and often struggle with changes in routines (Touhy & Yazdani, 2018). Children with NDD are also at higher risk for a variety of sleep disturbances (Chen et al., 2021; Esbensen & Schwichtenberg, 2016). According to previous studies, sleep disturbance has been reported in 67.3% of children with ASD (Chen et al., 2021), 28.5-44.8% of children with attention deficit hyperactivity disorder (ADHD) (Sung et al., 2008), and 24-86% of children with intellectual disabilities (Korb et al., 2021). In addition, 35-95% of children with NDD reported sleep related symptoms such as restless sleep, wakes very early and tired during daytime but only 15% of them reported complaints about sleep problems (Ashworth et al., 2013). 

Thus, a disruption to daily activities, educational routines, and scheduled therapies due to COVID-19 lockdowns may have been a source of stress leading to an exacerbation of sleep problems.
Synthesizing information on the impact COVID-19 restrictions on sleep is crucial to recovering from the pandemic and may also assist in preparing this vulnerable population for future public health stressors. Additionally, this information is crucial to providers in addressing parental questions and concerns while also providing therapeutic advice.

**Method**

The authors conducted an integrative review following the updated methodology described by Whittemore & Knafl, comprising a five step process: (1) Problem Identification, (2) Literature Search, (3) Data Evaluation, (4) Data Analysis and (5) Presentation (2005). The integrative review methodology allows researchers to summarize existing empirical studies with varied methodologies to provide a fuller understanding of a health care phenomenon (Broome, 1993). Although the method explicitly allows for the inclusion of theoretical literature, the authors chose to restrict their analysis to empirical studies.

**Problem Identification**

Sleep issues occur at higher rates in children with NDD than the typical population. Little is known about the impact of COVID-19 on sleep issues in this population. The purpose of this integrative review was to characterize empirical research studies focused on sleep behaviors in children and youth, ages birth to 21 years, with NDD during the COVID-19 pandemic (years 2020 – 2022).

**Literature Search**

The authors created comprehensive searches in PubMed, CINAHL, Embase (Embase.com), APA PsycInfo (EBSCOhost), and Scopus to identify articles that addressed sleep issues in children with NDD during the COVID-19 pandemic. The search strategy focused on four broad sets of terms including: (1) sleep and sleep disorders, (2) neurodevelopmental disorders, (3) children, and (4) COVID. The search
included keywords, database specific controlled vocabulary terms (e.g., MESH, Emtree, etc.), Boolean operators, and term truncation, as necessary, with the goal of maximizing search results. When appropriate, controlled vocabulary terms were “exploded,” a search process which enables simultaneously searching for a broad concept such as sleep disorders while searching for a list of specific sleep disorders. In order to maximize retrieval related to the COVID-19 pandemic, the authors used the CADTH PubMed and Scopus search strings and adapted the Embase search string, which was written for Ovid (2022). Since the search strings were not written for CINAHL and APA PsycInfo, the authors used them as a starting point to develop the COVID searches, substituting appropriate controlled vocabulary from each database (CADTH, 2022). The searches were finalized and conducted in each database on May 6, 2022, and limited to English language articles published 2020-2022. Interested readers can view the full text of the searches at https://doi.org/10.6084/m9.figshare.20186600.

Inclusion criteria were empirical studies that addressed children with NDD and sleep issues that specifically addressed the COVID-19 pandemic. For the purposes of this review, children were defined as birth to 21 years old because in the United States the Individuals with Disabilities Education Act (IDEA) provides services through 21 years of age (1990). Articles were excluded if they did not describe a study methodology, were not in English, not available in full text, or did not specifically address the impact of the COVID-19 pandemic on sleep in children with NDD.

Figure 1 shows the steps of the study selection process using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). The authors used Covidence systematic review management system (https://www.covidence.org/) to collaborate on the review process. Covidence removes duplicate references and enables team members to independently screen titles and abstracts for inclusion and full text articles for exclusion. When team members’ decisions differed, they discussed the studies via live meetings and email to reach consensus. Following
completion of all these steps, the authors identified 61 studies for full text review and selected 31 studies for data extraction.

Data Evaluation

Studies were evaluated using the “American Association of Critical Care Nurses” (AACN) Evidenced-Level hierarchy (Peterson, et al., 2014). This system includes five levels, A through E, and is effective when both quantitative and qualitative primary sources are included. Level A is the highest level of evidence and includes meta-analyses and meta-syntheses. Level E is the lowest level and includes case reports and expert opinion. All studies in this review met Level C evidence which encompasses qualitative, descriptive, or correlational studies, integrative reviews, systematic reviews, or some randomized controlled trials that bear inconsistent results. Because relatively few empirical studies have been published that address the COVID-19 pandemic’s impact on sleep in children with NDD, the authors chose the AACN hierarchy as the most appropriate method to evaluate the overall quality of studies. Evaluation methods also included ensuring that the studies fully addressed the research question and addressed specific research method. The authors chose to eliminate case studies, which they concluded provided minimal evidence that could be used to address the research question.

Data Analysis & Presentation

The authors constructed a matrix table to capture study characteristics including setting/country purpose, research design, time period, sample size and characteristics, and measurements/instruments used. After extracting the data to the matrix, the authors reviewed it for accuracy and completeness. The authors then thematically analyzed the results matrix to find commonalities and differences among them.
Samples

All 31 studies focused on children and youth with NDD either grouped or separated into specific populations. Twelve studies (39%) focused solely on ASD; whereas six studies (19%) enrolled participants with ADHD only. One study compared these two sample populations. Nine studies (29%) enrolled participants with a combination of neurodevelopmental disorders including ASD, ADHD, learning disabilities (LD), cerebral palsy (CP), or other physical, sensory, neurologic, or cognitive diagnoses. Three individual publications emerged for cerebral palsy, epilepsy, and Fragile X syndrome. See Table 1 for sample sizes.

Outcome Measures

Each of the 31 studies examined sleep in various ways. Six validated sleep instruments were employed in 11 quantitative studies. These tools included: *Sleep Habits Survey (SHS)* (Wolfson, et al., 2003), original or modified versions of *Sleep Disturbance Scale for Children (SDSC)* (Bruni, et al., 1996), *Children’s Sleep Habits Questionnaire (CSHQ)* (Owens, Spirito, & McGuinn, 2000), *Children’s Chronotype Questionnaire (CCQ)* (Zavada et al., 2005), *Pittsburgh Sleep Quality (PSQI)* (Buysse, et al., 1989), or BEARS sleep screening tool (Owens & Dalzell, 2005). Four studies assessed sleep using components of validated behavior assessment tools such as the *Child Behavior Checklist (CBCL)* (Achenbach & Edelbrock, 1991), *Vineland Adaptive Behavior Scale (VABS)* (Sparrow & Cicchetti, 1989), *Canadian Health Measures Survey* (adapted version) (Tremplay, et al., 2007), *Patient Health Questionnaire (PHQ-9)* (Spitzer, et al., 1999), and the *COVID-19 Stay-at-Home Cerebral Palsy Parental Questionnaire* (Biyik, et al., 2021). The remainder of quantitative studies included ad hoc sleep questions in surveys or study specific instruments (e.g., mCare tools). The one qualitative study employed a semi-structured phone interview (Tokatly Latzer, et al., 2021).
Findings

Findings are grouped by sample types and data collection measures.

**ASD, ADHD, Controls – Validated Sleep Tool**

During the lockdown, one study examined all three groups using the SDSC (Bruni, Breda, et al., 2021). Children with ADHD demonstrated later bedtime and risetime than those with ASD or controls. Both clinical groups significantly demonstrated a reduced sleep duration compared to controls. These two groups also had an increase in hypnic jerks, rhythmic movement disorders, night awakenings, restless sleep, sleep walking, and daytime sleepiness over the control group. Anxiety at bedtime, difficulties falling asleep, and daytime sleepiness increased in all groups.

**ASD - Validated Sleep Tools**

Using the SDSC, one study found significant increase in sleep disturbances, difficulty falling asleep, anxiety at bedtime, sleep terrors, and daytime sleepiness (Bompard, et al., 2021). Parents reported the following factors as having an impact on their child’s sleep: lack of obliged rise time, lack of sports activities, increased screen time, more time spent with family, and changes in routine (Bompard, et al., 2021). A study using the PSQI reported significant changes in sleep disturbance, sleep duration, and sleep quality during the pandemic (Mutluer et al., 2020). Parents who were asked to complete one copy of the CHSQ with reference to behaviors during the pandemic and one copy with reference to pre-pandemic behaviors, reported 89.3% of children had clinically significant sleep disturbances during the pandemic (Scarselli et al., 2022). However, these parents reported that sleep disturbances which were present prior to the pandemic either did not change or improved (Scarselli et al., 2022). Employing both the CSHQ and CCQ, researchers reported that children with ASD had significantly greater sleep problems.
and chronotype score (eveningness) during home confinement and sleep problems mediated the
relationship between chronotype score and severity of autism symptoms (Türkoğlu et al., 2020).

**ASD - Surveys**

When parents were asked to rate changes in their child’s sleep during the pandemic the
majority of respondents reported no change in sleep (55.5%) but when a change was reported it was
perceived as worsening (Berard et al., 2021). These authors also performed a multi-variate analysis that
revealed that a higher the Autism Diagnostic Observation Schedule-2 (ADOS) score was associated with
a decreased probability of improvement in sleep and belonging to a single parent home was associated
with worsening sleep (Berard et al., 2021). An observational study of nine adolescents with ASD found
that while sleep and wake times may have shifted there were no reported differences for sleep duration
pre- or during pandemic (Garcia et al., 2021). A survey with a larger sample size discovered that half the
parents reported sleep problems in their children along with reduced outdoor activity and these families
also reported a lack of professional support during the pandemic (Huang et al., 2021). Similar findings
were reported from Spain where 56% of caregivers reported sleep quality worsened in their children
with ASD (Lugo-Marín, et al., 2021). A parent survey that focused on activities of daily living, play, and
sensory behaviors identified 67% of the sample as having inconsistent sleep routines; the occupation of
homemaker was 2.51 times more likely to report difficulty in managing their child’s sleep schedule
(Nithya et al., 2021). When comparing children with ASD to a control group, children with ASD
demonstrated a significantly later bedtime but as COVID-19 lockdown progressed sleep routines
partially returned to pre-COVID-19 condition (Polónyiová et al., 2021).

**ASD – Study Specific Tools**
A longitudinal study that used two mCare tools to gather pre-lockdown, lockdown, and post-lockdown information on thirty behavioral parameters found four behaviors (i.e., aggression, lack of concentration, sensitivity to pain, sleep problems) were negatively impacted during the lockdown (Rabbani et al., 2021).

**ASD - Qualitative**

Through a semi-structured phone interview, researchers found sleep to be a common topic. Challenges were shared about children with ASD having difficulties falling asleep or frequent awakenings or night terrors. The situation was compounded by outpatient clinics being closed; some parents explored new ways to deal with their child's sleep issues (e.g., obtaining melatonin from another country) (Tokatly Latzer et al., 2021).

**ADHD – Validated Sleep Tools**

In a prospective study parents completed the SHS and adolescents with ADHD completed the SDSC, findings indicated shifts in sleep/wake schedules and longer sleep duration with clinically elevated rates of difficulties initiating and maintaining sleep (DIMS); more worried/afraid affect and less time outdoors correlated with more delayed sleep/wake behaviors (Becker et al., 2021). In a large sample of children and adolescents with ADHD, a modified version of the SDSC showed the imposed COVID-19 lockdown affected sleep-wake rhythm dramatically from previous bedtime behaviors and these changes were associated with increased screentime (Bruni, Giallonardo, et al., 2021). One study that used both the CSHQ and CCQ along with the perception of trauma found eveningness chronotypes exhibited higher trauma symptoms and sleep problems, higher trauma scores were associated with higher chronotype scores, sleep problems, and oppositional defiant disorder (ODD) symptoms, sleep levels mediated the relationship between trauma and ODD symptoms, and sleep levels mediated the relationship between
trauma and chronotype scores (Çetin et al., 2020). When comparing children and adolescents with and without ADHD, those with ADHD were more negatively affected by the lockdown and had higher reported sleep problems, anxiety, and executive function issues (Navarro-Soria et al., 2021).

**ADHD - Surveys**

The Adolescent Brain and Cognitive Development Study compared youth with ADHD and matched controls without ADHD and found one year into the pandemic that youth with ADHD exhibited greater sleep problems with medium effect sizes (d = -0.52); the combined main effects of ADHD medication, ADHD diagnostic status, and screen time were significant predictors of sleep problems (Rosenthal, et al., 2021). In a study investigating lifestyle behaviors in children with ADHD during the pandemic, these youth showed the worsening changes in sleep, eating, screen time, and exercise with reported correlations to depression, anxiety and ADHD symptoms (Swansburg et al., 2021).

**Neurodevelopmental Groups – Validated Sleep Tools**

A prospective non-controlled pilot study, using the SDSC, investigated the impact of a home-based music therapy intervention and observed significant improvements in sleep quality and reduction of parental stress in a cohort of children with developmental delay (Bompard et al., 2021). A quasi-experimental study using the CSHQ-S before and after pediatricians addressed sleep hygiene found half of the children with developmental delay had sleep problems which worsened during the pandemic, insomnia being most prevalent; pediatricians addressed sleep hygiene in only 45% of cases but the intervention was found to be beneficial for most cases (Micheletti et al., 2021).

**Neurodevelopmental Groups – Surveys**
The CBCL subscale for sleep problems revealed a clinically worsening condition during the pandemic in younger children with neurologic and/or psychiatric disorders (Conti et al., 2020). A large web-based survey examined sleep disorders in children less than 18 years old including those with disabilities, ASD, chronic disorders, and specific learning disabilities; results indicated more difficulties falling asleep, staying asleep, and increased frequency in nightmares and/or sleep terrors with additional analyses identifying multiple risk factors (Dondi et al., 2021). Delayed sleep phase and dyssomnia were most frequently reported sleep problems in a survey investigating emotional and behavioral responses of children with neurodevelopmental disorders to the pandemic (Guller et al., 2021). In two similarly designed studies, reduced sleep quality and worsening sleep in children with neurodevelopmental disabilities and comorbidities was reported (Masi et al., 2021; Mete Yesil et al., 2022). The National Physical Activity Measurement Study surveyed parents of children and youth with developmental, physical, and/or sensory type of disabilities and reported a slight increase in sleep quantity, and parent capacity and opportunity to support child’s sleep was associated with better sleep quality (Moore et al., 2021). Worsening sleep patterns in children with neurodevelopmental disorders was one of several factors associated with low quality of life for both parents and children during COVID-19 (Ueda et al., 2021).

**Specific Conditions - Surveys**

A prospective investigation on the functional health status of children with cerebral palsy reported that 17.5% experienced a decrease in sleep duration while 25.2% experienced an increase in sleep duration (Biyik et al., 2021). Children with Fragile X syndrome demonstrated significant sleep changes during the lockdown including difficulties falling asleep, longer falling asleep time, and frequency of night awakenings (Di Giorgio et al., 2021). During the lockdown, sleep disorders worsened for 17 % with 2.2% needing pharmacological treatment (Trivisano et al., 2020).
Discussion

The impact of the COVID-19 pandemic and subsequent lockdowns was a universal phenomenon. The studies selected in this review represented a variety of countries that experienced similar restrictions. Although studies varied in number of participants, tools used to measure changes in sleep, and study design, all participant sampling focused on children with NDD. A common hypothesis among the studies was that children with NDD have higher rates of reported sleep problems in the most typical of times.

All but two studies which enrolled ASD participants reported worsening sleep behaviors. A noted difference in the two studies was sample size. Scarselli et al. (2022) had 28 participants who had clinically significant sleep problems prior to the pandemic and reported that sleep problems either did not change or improved. Garcia et al. (2021) enrolled nine participants and reported no changes in sleep duration but only shifting of sleep times.

Several studies with ASD participants investigated correlations with sleep. Children with higher ADOS scores, belonging to single parent household, the occupation of homemaker, and less time outdoors were associated with worsened sleep (Berard et al., 2021; Huang et al., 2021, Nithya et al., 2021).

All studies with ADHD participants reported consistent worsening sleep problems along with other behavioral changes. Predictors of sleep quality in this population included ADHD medication, diagnostic status, and screen time (Rosenthal, et al., 2021). Screen time also effected sleep-wake rhythms (Bruni, Giallonardo, et al., 2021). Worsening changes in several lifestyle behaviors including sleep were associated with anxiety, depression, and ADHD symptoms (Swansburg et al., 2021). Sleep
was also found to be a mediator of behavior and perception of trauma during COVID-19 (Çetin et al., 2020).

Only two studies addressed treatment options for children with developmental delays and saw improvements in addressing the sleep issues (Bompard, et al., 2021; Micheletti, et al., 2021). All studies included in this review were conducted at a time when clinics were closed, and behavioral support and treatment options was minimally available. Without treatment options, the quality of life for families was challenged (Ueda et al., 2021).

Overall, this integrative review uncovered a trend towards worsening sleep problems in a sample of international studies focusing on children with NDD. These studies underscored the fact that sleep behaviors rarely occur in isolation but can predict, mediate, or be associated with other personal or environmental factors. All studies included in this review measured sleep using subjective instruments. Strong evidence supports the use of the actigraphy to objectively monitor and track sleep in children with neurodevelopment disorders (Alder et al., 2020; Yavuz-Kodat et al., 2019). The actigraph device measures sleep in home setting and is considered as an objective method for measuring sleep onset, sleep-wake patterns, and sleep duration. Future studies should consider this method to provide objective and detailed data to obtain valuable information about this population. Future research will also need to concentrate on developing interventions that consider personal or environmental factors to assist families during periods of isolation and when clinical supports are lacking. It would behoove clinicians to assimilate techniques that easily transfer to home-based interventions and that can empower families with a toolkit of preparedness in times of crises.

The authors would like to add one final note. Providing in-depth assessment and treatment options for sleep problems in children with NDD are beyond the scope of this integrative review.
Comprehensive practice guidelines for the treatment of insomnia and disrupted sleep in ASD have been developed by a subcommittee of the American Academy of Neurology (Buckley, et al., 2020). These guidelines provide evidenced based recommendations for both non-pharmacologic and pharmacologic treatment options. We encourage clinicians to refer to these guidelines and develop their own sleep assessment and treatment toolkit based on the unique needs of their practice population. Since the first crucial step to effectively addressing sleep problems is gaining a thorough understanding of the scope and characteristics of the chief concerns, we offer Table 2 which includes a summary of validated sleep assessment tools and additional resources for ease of reference.

Ethical Statement

This submission was designed as an Integrative Review. No IRB permissions were needed for this research. Authors testify this is their original work.

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https://doi.org/10.1016/s0002-7188(09)60942-0


**Table 1**

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<th>Author (Year)</th>
<th>Purpose</th>
<th>Design</th>
<th>Time period</th>
<th>Sample</th>
<th>Measurements</th>
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<td>Study Description</td>
<td>Study Design</td>
<td>Time Period</td>
<td>Sample Size</td>
<td>Outcome Measures</td>
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<tr>
<td>Becker et al. (2021) USA</td>
<td>To prospectively examine changes in adolescent sleep before and during the COVID-19 pandemic in adolescents with and without ADHD.</td>
<td>Prospective</td>
<td>Before September 2019 to February 2020 and during May–June 2020</td>
<td>122 adolescents ages 15-17 years with and without ADHD</td>
<td>Sleep Habits Questionnaire, Sleep Disturbance Scale for Children, COVID-19 Adolescent Symptom and Psychological Experience Questionnaire, Coronavirus Health Impact Survey</td>
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<tr>
<td>Berard et al. (2021) France</td>
<td>To examine the impact of COVID-19 containment and mitigation efforts on behaviors, communication, sleep and nutrition.</td>
<td>Cross-sectional, descriptive</td>
<td>April to May 2020</td>
<td>229 ASD children and youth part of the ELENA cohort ages 2 – 21 years</td>
<td>A four-part COVID-19 parent structured questionnaire, Vineland Adaptive Behavior Scales, Second Edition (VABS-II), calibrated severity score (CSS) of the Autism Diagnostic Observation Schedule-2 (ADOS-2)</td>
</tr>
<tr>
<td>Biyik et al. (2021)</td>
<td>To investigate the effects</td>
<td>Prospective</td>
<td>May to June 2020</td>
<td>103 children with CP ages 2-</td>
<td>COVID-19 Stay-at-Home</td>
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<td>Country</td>
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<tr>
<td>Turkey</td>
<td>Investigation of the COVID-19 pandemic on body structures and functions, activity and participation levels, and environmental factors of children with cerebral palsy (CP).</td>
<td>18 years.</td>
<td></td>
<td>Cerebral Palsy Parental Questionnaire, Gross Motor Function Classification System Family Report Questionnaire (GMFCS-FR)</td>
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<tr>
<td>Bompard et al. (2021) Italy</td>
<td>To investigate the feasibility and impact of a home-based music therapy program to sustain children with developmental disorders secondary to neurological diseases and their parents.</td>
<td>Prospective, monocentric, non-controlled pilot</td>
<td>May to March 2020</td>
<td>12 children with developmental delay.</td>
<td>Gross Motor Function Classification System (GMFCS), Sleep Disturbance Scale for Children (SDSC), Parent Stress Index-Short Form (PSI-SF)</td>
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<td>Bruni, Breda, et al. (2021) Italy</td>
<td>To evaluate different responses in two clinical conditions, ASD and ADHD, in terms of sleep patterns and disturbances.</td>
<td>Descriptive</td>
<td>May to June 2020</td>
<td>Parents of 100 ASD, 236 ADHD patients, and 340 healthy controls, ages 4 – 18 years.</td>
<td>Modified version of the Sleep Disturbance Scale for Children (SDSC)</td>
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<td>Study Details</td>
<td>Methodology</td>
<td>Sample Size and Characteristics</td>
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<tr>
<td>Bruni, Giallonardo, et al. (2021) Italy</td>
<td>To examine the impact of home confinement (lockdown) because of the COVID-19 pandemic on the sleep patterns of children and adolescents with attention-deficit hyperactivity disorder (ADHD)</td>
<td>Descriptive</td>
<td>June 2020</td>
<td>992 children with ADHD, ages 5-17 years</td>
<td>Modified version of the Sleep Disturbance Scale for Children (SDSC)</td>
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<tr>
<td>Bruni, Melegari, et al. (2022) Italy</td>
<td>To evaluate the impact of the lockdown on sleep patterns and sleep disturbances, with respect to the preceding conditions in children and adolescents with ASD.</td>
<td>Descriptive</td>
<td>May to June 2020</td>
<td>111 participants with ASD, ages 1 to 18 years</td>
<td>Modified version of the Sleep Disturbance Scale for Children (SDSC)</td>
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<td>Çetin et al. (2020) Turkey</td>
<td>To investigate the relationship between chronotype preference/sleep problems and symptom severity of children with ADHD and to assess the</td>
<td>Cross-sectional</td>
<td>May 2020</td>
<td>76 children with ADHD, ages 8 to 12 years</td>
<td>Children’s Impact of Event Scale (CRIES-8), Children’s Sleep Habits Questionnaire (CSHQ), Children’s Chronotype Questionnaire (CCQ), Turgay</td>
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<tr>
<td>Conti et al. (2020) Italy</td>
<td>To investigate lockdown-related emotional and behavioral changes in pediatric neuropsychiatric population</td>
<td>Observational, longitudinal</td>
<td>Pre-pandemic September 2019 and February 2020; pandemic collection April to May 2020</td>
<td>141 children with neuropsychiatric disorders, ages 1.5 to 18 years</td>
<td>DSM-IV Disruptive Behavior Disorders Rating Scale (T-DSM-IV-S).</td>
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<tr>
<td>Di Giorgio et al. (2021) Italy</td>
<td>To investigate how the lockdown impacted children with Fragile X-Syndrome (FXS)</td>
<td>Descriptive</td>
<td>April to May 2020</td>
<td>53 children with FXS, ages 3 to 16 years</td>
<td>General questionnaire, Child Behavior Check List (CBCL)</td>
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<td>Dondi et al. (2021)</td>
<td>To evaluate the effects of</td>
<td>Cross-sectional</td>
<td>September to October</td>
<td>6210 children, ages 0 to 18</td>
<td>78 question web-based</td>
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<tr>
<td>Italy</td>
<td>COVID-19 quarantine on sleep quality as an indicator of psychological well-being among children and adolescents</td>
<td>2020</td>
<td>years including children affected with specific learning disabilities, ASD, other disabilities, chronic diseases and multiple conditions</td>
<td>survey</td>
<td></td>
</tr>
<tr>
<td>Garcia et al. (2021) USA</td>
<td>To examine changes in physical activity, screen-time, and sleep in adolescents with ASD due to the COVID-19 pandemic.</td>
<td>April 2020</td>
<td>nine students with ASD, age 16.87 ± 1.36 years</td>
<td>Surveys measuring physical activity, screen-time, and sleep duration prior to and during the pandemic.</td>
<td></td>
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<tr>
<td>Guller et al. (2021) Turkey</td>
<td>To investigate the emotional and behavioral responses of children with neurodevelopmental disorders and their parents during the recent novel coronavirus disease (COVID-19) pandemic and</td>
<td>April 2020</td>
<td>299 children and adolescents with neurodevelopmental disorders, ages 2 to 18 years</td>
<td>Sociodemographic form and COVID-19 pandemic-related characteristics, Hospital anxiety and depression scale (HADS)</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Objective</td>
<td>Design</td>
<td>Timeframe</td>
<td>Sample Characteristics</td>
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<tr>
<td>Huang et al. (2021) China</td>
<td>To investigate</td>
<td>the impact of the COVID-19 pandemic on ASD children and their families.</td>
<td>Cross-sectional</td>
<td>May 2020</td>
<td>406 children with ASD, mean age 4.6 years (SD=2.3)</td>
</tr>
<tr>
<td>Lugo-Marin, et al., (2021) Spain</td>
<td>To study the psychological impact of the lockdown due to the social emergency situation (COVID-19) in children/adolescents and adults diagnosed with ASD.</td>
<td>Not specified</td>
<td>8 weeks after lockdown</td>
<td>Sample was subdivided into two ASD groups, 37 children/adolescents (3 years - 17 years and 11 months), and 35 adults (18 years or older)</td>
<td>Child Behavior Checklist (CBCL), Symptom Checklist 90 Revised (SCL-90) for adults</td>
</tr>
<tr>
<td>Masi et al. (2021) Australia</td>
<td>To examine the impact of COVID-19 pandemic on child mental health and socio-emotional and physical well-being (including sleep, diet, exercise, use of electronic</td>
<td>Cross-sectional</td>
<td>May to June 2020</td>
<td>302 caregivers of children with neurodevelopmental disabilities, ages 2 to 17 years</td>
<td>Child symptom severity and well-being, parent well-being, and service access and satisfaction questionnaire</td>
</tr>
<tr>
<td>Study</td>
<td>Title</td>
<td>Country</td>
<td>Methodology</td>
<td>Participants</td>
<td>Data Collection</td>
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<tr>
<td>Mete Yesil et al. (2022)</td>
<td>To explore how the lives of children with special needs and their families were affected by the COVID-19 pandemic.</td>
<td>Turkey</td>
<td>Descriptive</td>
<td>117 children with DD, ASD, hearing or language impairments, and receiving special education, ages 4 to 6 years</td>
<td>5-part questionnaire focusing on the amount of change caused by the COVID-19 pandemic on feeding, toilet habits, daily routines, development, physical activities, daily activities, one-on-one time durations with parents, screen time, and whether and how much they performed and maintained</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Objective</td>
<td>Study Design</td>
<td>Time Period</td>
<td>Sample Description</td>
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<tr>
<td>Micheletti et al. (2021)</td>
<td>Argentina</td>
<td>To define the frequency and types of sleep problems in a sample of children with DDs, determine the proportion of pediatricians who addressed such difficulties, assess the effects of sleep hygiene (SH) and describe the impact of the COVID-19 pandemic on sleep.</td>
<td>Quasi-experimental</td>
<td>May 2020</td>
<td>161 children with DDs, ages 1 to 6 years, who attended clinic visit between July 2019 and March 2020 with follow-up before July 2020</td>
</tr>
<tr>
<td>Moore et al. (2021)</td>
<td>Canada</td>
<td>To assess parent-perceived changes in Physical activity, Sedentary behavior, and sleep</td>
<td>Not specified</td>
<td>April and May 2020</td>
<td>151 children with disabilities, ages 4 to 17 years</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Objective</td>
<td>Methodology</td>
<td>Sample Size</td>
<td>Measures</td>
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<tr>
<td>Mutluer et al. (2020)</td>
<td>Turkey</td>
<td>To investigate how individuals with ASD responded to Covid-19 regarding their comprehension and adherence to implemented measures; changes in their behavioral problems; and how their caregivers' anxiety levels relate with these behavioral changes.</td>
<td>Not specified</td>
<td>87 individuals with ASD, mean age 13.96 ± 6.1, and age range of 3–29 years</td>
<td>Amended version of the 2020 COVID-19 and Childhood Movement Behaviors Survey</td>
</tr>
<tr>
<td>Navarro-Soria et al. (2021)</td>
<td>Spain</td>
<td>To evaluate the consequences of the lockdown in children and teenagers diagnosed with attention deficit</td>
<td>Associative - comparative and explanatory</td>
<td>234 children divided into two groups, confined ADHD and confined non-ADHD, ages 6 to 18 years</td>
<td>Aberrant Behavior Checklist (ABC), Pittsburgh Sleep Quality Index (PSQI), Beck Anxiety Inventory (BAI)</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Research Question</td>
<td>Study Design</td>
<td>Sample Size</td>
<td>Measures</td>
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<tr>
<td>Nithya et al. (2021)</td>
<td>India</td>
<td>To systematically assess the impact of the COVID-19 pandemic on activities of daily living (ADL), play, and sensory behaviors of children with autism spectrum disorder (ASD).</td>
<td>Cross Sectional</td>
<td>100 children with ASD, ages 2 to above 10 years</td>
<td>A structured ADL, play, sensory behavior questionnaire (45 items)</td>
</tr>
<tr>
<td>Polónyiová et al. (2021)</td>
<td>Slovakia</td>
<td>To explore how the first and second wave of COVID-19 outbreak affected the</td>
<td>Not specified</td>
<td>332 caregivers, 155 of having children with ASD, (179 surveyed during the first wave and 153</td>
<td>Depression Anxiety and Stress Scale (DASS-42), subscales of Vineland-3</td>
</tr>
</tbody>
</table>
mental health of families in Slovakia, with the focus on comparison of families with autistic children to a general sample. Focused on the prevalence of depression, anxiety, and stress symptoms among the parents and maladaptive behavior or sleep disturbances of their children as well as their correlations.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Objective</th>
<th>Methods</th>
<th>Participants</th>
<th>Tools</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabbani et al. (2021) Bangladesh</td>
<td>To evaluate behavioral patterns of risk and resilience for children with ASD</td>
<td>Longitudinal</td>
<td>November 2019 to November 2020</td>
<td>150 children with ASD, ages 2 to 9 years</td>
<td>Two mCARE tools assessed 30 behavioral parameters</td>
<td></td>
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<tr>
<td>Rosenthal, et al. (2021) USA</td>
<td>To examine the impact of COVID-19 on youth with ADHD during</td>
<td>Longitudinal</td>
<td>May 2020 and March 2021</td>
<td>620 youth with ADHD and 614 individually matched controls participating in Pre-pandemic functioning: Kiddie schedule for affective</td>
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<tr>
<td>Study</td>
<td>Aim</td>
<td>Methods</td>
<td>Participants</td>
<td>Findings</td>
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<tr>
<td>Scarselli et al. (2022) Italy</td>
<td>To study change in sleep habits of children with ASD during the Covid-19 pandemic</td>
<td>Not specified</td>
<td>April to June 2020</td>
<td>28 children with ASD, ages 2 to 6 years</td>
<td>Children’s Sleep Habits Questionnaire (CSHQ)</td>
<td></td>
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<tr>
<td>Swansburg et al. (2021)</td>
<td>To understand the impact of the COVID-19 pandemic on</td>
<td>Not specified</td>
<td>May to June 2020</td>
<td>587 children with ADHD, ages 5 to 18 years</td>
<td>Survey with lifestyle questions; Patient Health</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Study Title</td>
<td>Methodology</td>
<td>Timeframe</td>
<td>Sample Description</td>
<td>Instruments</td>
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<tr>
<td>Canada</td>
<td>Lifestyle habits, mental health symptoms, and ADHD behaviors in children with ADHD.</td>
<td>Questionnaire 9 (PHQ-9), Generalized Anxiety Disorder 7 (GAD-7), Swanson, Nolan, and Pelham (SNAP-IV)</td>
<td></td>
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<tr>
<td>Tokatly Latzer et al. (2021) Israel</td>
<td>To explore and characterize in-depth the experiences of parents and children with autism who have been going through Covid-19 lockdown</td>
<td>Qualitative</td>
<td>April 2020</td>
<td>25 children with autism, age 4 to 6 years;</td>
<td>Semi-structured telephone interviews</td>
<td></td>
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<tr>
<td>Trivisano et al. (2020) Italy</td>
<td>To assess how the COVID-19 pandemic has affected children with epilepsy</td>
<td>Not specified</td>
<td>May 2020</td>
<td>3321 responses to survey (96.6% caregivers of patients ages 0 to &gt; then 18 years.) 59.7% of patients had intellectual disability and 44.3% had behavioral disturbances.</td>
<td>45-item questionnaire</td>
<td></td>
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<tr>
<td>Türkoğlu et al.</td>
<td>To investigate the relationship</td>
<td>Not</td>
<td>May 2020</td>
<td>46 drug-naive children with Autism Behavior</td>
<td></td>
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<tr>
<td>Year</td>
<td>Country</td>
<td>Study Description</td>
<td>Data Collection Period</td>
<td>Population Details</td>
<td>Instruments/Measures</td>
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<tr>
<td>2020</td>
<td>Turkey</td>
<td>between chronotype preference/sleep problems and symptom severity of children with Autism spectrum disorder (ASD) during the confinement and social isolation of the COVID-19 outbreak</td>
<td>specified</td>
<td>ASD, age 4 to 17 years</td>
<td>Checklist (AuBC), Children’s Sleep Habits Questionnaire (CSHQ), and Children’s chronotype questionnaire (CC)</td>
<td></td>
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<tr>
<td>2021</td>
<td>Japan</td>
<td>To evaluate how the QOL of children and their parents has been affected by changes in the sleep cycles of children with NDDs and stresses caused by mothers’ work patterns during the COVID-19 pandemic.</td>
<td>Not specified</td>
<td>136 school-age children with IDD, mean age 10.6 +/- 2.6</td>
<td>Child behavior checklist (CBCL), Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV), World health organization quality of life (WHO-QOL-BREF), Center for Epidemiologic Studies Depression scale (CES-D), State-trait Anxiety Inventory (STAI), Parental Stress</td>
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</tbody>
</table>
TABLE 2 Validated Sleep Assessment Tools often used in Children with NDD

<table>
<thead>
<tr>
<th>Screening Tool</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children’s Sleep Habits Questionnaire (CSHQ)</td>
<td>33-item scale consists of eight subscales: (1) Bedtime Resistance; (2) Sleep Onset Delay; (3) Sleep Duration; (4) Sleep Anxiety; (5) Night Wakings; (6) Parasomnias; (7) Sleep Disordered Breathing; and (8) Daytime Sleepiness.</td>
<td>Owens, J. A., Spirito, A., &amp; McGuinn, M. (2000). The Children’s Sleep Habits Questionnaire (CSHQ): Psychometric properties of a survey instrument for school-aged children. <em>Sleep</em>, 23(8), 1043-1052.</td>
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<tr>
<td>Disorders of excessive somnolence, and sleep hyperhidrosis (nighttime sweating.)</td>
<td><a href="https://doi.org/10.1111/j.1365-2869.1996.00251.x">https://doi.org/10.1111/j.1365-2869.1996.00251.x</a></td>
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</table>

**Additional Resources**


Autism Treatment Network Sleep Toolkit, Vanderbilt University, Nashville Tennessee

Records identified through database searching 
\( (n = 688) \)

Additional records identified through other sources 
\( (n = 0) \)

Records after duplicates removed 
\( (n = 515) \)

Records screened 
\( (n = 515) \)

Records excluded 
\( (n = 454) \)

Full-text articles assessed for eligibility 
\( (n = 61) \)

Full-text articles excluded, with reasons 
\( (n = 30) \)

10 Wrong study design
9 Conference presentation 
(full text not available)
5 Insufficiently addressed

Studies included in qualitative synthesis 
\( (n = 31) \)

Studies included in quantitative synthesis (meta-analysis) 
\( (n = 0c) \)