

Neuropsychological Impact of COVID-19 on Children and Adolescents

Christine H. Koterba^{1,2}  · Gray Vargas³ · Rowena Ng^{3,4} · Kristen R. Hoskinson^{2,5}

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Abstract

Since the start of the pandemic, over 15 million youth have tested positive for COVID-19 (American Academy of Pediatrics [AAP], 2023), but less is known about the impact of COVID-19 in children compared to adults. While children generally experience fewer and less severe acute symptoms, a subgroup of children may become quite ill with COVID-19 or multisystem inflammatory syndrome in children (MIS-C). Like adults, a minority of children also go on to develop what is now known as “pediatric long COVID”. Research in children with COVID-19 is limited, but emerging studies suggest that, like adults, children with more severe or persisting forms of COVID-19, including long COVID, may be at risk for a range of physical, cognitive, and emotional/behavioral symptoms. Pediatric neuropsychologists are uniquely positioned to assess neurocognitive functioning in children with COVID-19, help children and families understand the factors affecting the child’s functioning, and provide recommendations for appropriate interventions and management at home, at school, and in the community.

Keywords COVID-19 · Long COVID · Pediatrics · Children · Cognitive

Introduction

Since the start of the pandemic, over 15 million youth have tested positive for COVID-19 (American Academy of Pediatrics [AAP], 2023), but less is known about the impact of COVID-19 in children compared to adults. Fortunately, children generally experience less severe acute symptoms than adults and are hospitalized at significantly lower rates. Nevertheless, some youth have more acute severe illness, including multisystem inflammatory syndrome in children (MIS-C) or intensive care admissions due to severe symptoms (Leidman et al., 2021). Others develop prolonged

symptoms which may impact cognition, behavior, emotional functioning, and quality of life, now known as “pediatric long COVID” (Rao et al., 2022). Further complicating matters, the pandemic has been disruptive, frightening, and unpredictable, which almost certainly has adversely impacted youth (Ding et al., 2022; Gadermann et al., 2021; Marzilli et al., 2021).

Although limited, research suggests that children and adults with severe infections and those who develop long COVID are at increased risk for neurological symptoms, emotional and behavioral difficulties, and functional decline (Rao et al., 2022). Given this constellation of symptoms, pediatric neuropsychologists are uniquely positioned to address the diverse needs of youth with COVID-19, particularly cases with severe acute illness, MIS-C, and/or prolonged and debilitating symptoms (i.e., long COVID). Pediatric neuropsychologists can help assess cognitive and emotional functioning and help understand factors that may be contributing to reported cognitive and school difficulties and the child’s overall functioning. Pediatric neuropsychologists can also use that information to make recommendations for treatment approaches as well as for home and school, which in turn may improve quality of life.

Several limitations can impact the generalizability of findings of the available research on COVID-related cognitive outcomes. Notably, many studies and reviews combine

✉ Christine H. Koterba
Christine.koterba@nationwidechildrens.org

¹ Department of Neuropsychology, Nationwide Children’s Hospital, Columbus, OH, USA

² Division of Pediatrics, The Ohio State University College of Medicine, Columbus, OH, USA

³ Department of Neuropsychology, Kennedy Krieger Institute, Baltimore, MD, USA

⁴ Department of Psychiatry and Behavioral Sciences, Johns Hopkins School of Medicine, Baltimore, MD, USA

⁵ Center for Biobehavioral Health, Abigail Wexner Research Institute at Nationwide Children’s Hospital, Columbus, OH, USA

subjectively reported cognitive difficulties, clinically diagnosed cognitive difficulties, and/or deficits on objective cognitive testing (e.g., Behnood et al., 2022; Ceban et al., 2022; Selvakumar et al., 2023). However, because these constructs do not always correlate highly, this can be problematic when attempting to understand the literature (Ten Eycke & Dewey, 2016; Vriezen & Pigott, 2002). How impairment is defined also often varies. For example, some larger medical record studies (e.g., Taquet et al., 2022) used a composite of several ICD-10 codes to capture “brain fog.” However, criteria for providing these codes are not clear and could vary between providers. A number of other factors, such as mood symptoms (e.g., anxiety, depression) and stress, can impact cognitive functioning, particularly in the areas of attention, working memory, and processing speed (which have been implicated in COVID research). Furthermore, stress related to long COVID symptoms, hospitalization, and/or functional changes can impact children and their families, which in turn can influence cognitive and social functioning. However, mood symptoms and stress levels are not adequately accounted for in many studies. Lastly, many studies do not include validity testing, which is crucial when interpreting test findings (Sweet et al., 2021).

The current paper will briefly summarize the impact of COVID-19 on children and adolescents, with a specific focus on cognitive outcomes in an effort to generate suggestions for pediatric neuropsychologists working with this population. As the research on COVID-19 in both adults and children is continuing to rapidly evolve, this is not intended to be an exhaustive literature review, but rather a focused review on relevant cognitive studies that may be of interest to pediatric neuropsychologists. Existing research will be summarized for three groups of youth with complicated forms of COVID-19, including children hospitalized with severe COVID-19 infection, children with MIS-C, and children who develop long COVID. We have attempted to differentiate between subjectively and objectively reported symptoms when discussing studies. Finally, we offer suggestions for pediatric neuropsychologists and provide a list of resources that can be helpful for patients, families, and providers.

Acute Complexities: Children Hospitalized Due to Severe COVID-19 Infection

As the vast majority of children experience a much less severe acute course of COVID-19 infection than adults, the rates of hospitalization are also much lower in pediatric populations than in older adults (Gkentzi et al., 2022; Hoang et al., 2020; Shekerdemian et al., 2020). Indeed, according to the US Centers for Disease Control and Prevention (CDC), roughly 14,370 children under 18 years of age have been hospitalized due to COVID-19 since the start of the

pandemic through June 2023 (0.09% of total pediatric cases; COVID-NET, 2023). Similar to adults, children with pre-existing medical conditions (e.g., obesity, diabetes, asthma, chronic lung disease, sickle cell disease, immunocompromising conditions) are more likely to experience significant illness and subsequent hospitalization (CDC, 2023). The striking difference in illness severity between adults and children can be explained by a number of factors. Zimmermann and Curtis (2021) explain that certain factors tied to the risk of COVID-related complications become more prevalent with increasing age (e.g., endothelium and clotting function, changes in certain genes, pre-existing immunity, immunosenescence and age-related inflammation increases, increased comorbid conditions, and lower vitamin D). Other factors are considered protective for children (stronger immune system along with a weaker immune response thus reducing hyperinflammation, recurrent infections, pre-existing exposure to neutralizing antibodies, differences in microbiota, higher melatonin levels, more recent vaccinations with off-target effects, and limited exposure compared to adults).

Neurocognitive Impact of Severe COVID-19 Infection in Children

Research specific to children hospitalized with COVID infection is unfortunately very limited. In adults, however, a recent study compared 85 adults hospitalized for COVID-19 to a group of 61 adults hospitalized for other reasons in Copenhagen, Denmark (Nersesjan et al., 2022). Nersesjan and colleagues (Nersesjan et al., 2022) found that about 20% of adults experienced new psychiatric disorders, but this did not significantly differ between patients with COVID-19 and those hospitalized for other causes. Indeed, a portion of all individuals who spend time in intensive care units have persisting cognitive and/or psychiatric difficulties, and this is thought to be due to multiple factors including stress, poor sleep, mechanical ventilation, microvascular ischemia and injury, and immobility and metabolic alterations (Sakusic & Rabinstein, 2018).

This study also examined cognitive functioning using a brief screen (Mini-International Neuropsychiatric Interview and Montreal Cognitive Assessment [MoCA]) and found that while many patients had low scores at discharge, these had largely improved at 6-month follow-up. That said, the COVID-19 group had significantly lower MoCA scores at follow-up than controls. Almost half of patients with COVID-19 self-reported difficulties with memory, although this did not differ from the control group and memory was not thoroughly assessed in this study (Nersesjan et al., 2022). Tentatively, this suggests the potential for some lingering impact of COVID-19 on cognition, even after acute recovery and discharge from hospitalization. That said, the battery of tests was very limited and did not include validity testing.

In one of the few studies that examined cognitive outcomes following hospitalization in adolescents with COVID-19, Frolli and colleagues (Frolli et al., 2021) compared cognitive performance across children with varying levels of infection 3 months after infection: those without known infection; those who had an asymptomatic infection; those who had symptoms but were not hospitalized; and those who were hospitalized due to severe symptoms. Youth were administered measures of overall intelligence, executive function, and visuospatial memory. Family history and a psychiatric diagnostic interview were also completed. Researchers did not find significant differences between groups in terms of verbal skills or overall intelligence. However, those with COVID-19 symptoms (but no hospitalization) were found to perform worse on measures of executive functioning and visuospatial memory when compared to children without COVID-19. Striking differences were also found between children who were hospitalized versus those without a history of COVID-19 on measures of executive functioning and visuospatial skills as well as the perceptual reasoning, working memory, and processing speed indices of the Wechsler Intelligence Scale for Children-4th edition. Authors conclude that children who experience more severe COVID-19 infections may be at greater risk for cognitive difficulties, particularly in the areas of executive functioning and attention (Frolli et al., 2021). That said, because the authors did not include a control group of children hospitalized for non-COVID-related illnesses, it is difficult to determine whether these findings are effects of hospitalization or specific disease effects.

Children Hospitalized Due to MIS-C

While most pediatric COVID-19 cases are mild, nearly 9500 children in the USA have been diagnosed with MIS-C following COVID-19 (CDC, 2023). This rare but serious condition is phenotypically similar to Kawasaki disease and involves inflammation of several organ systems (Verdoni et al., 2020). Severe MIS-C can lead to significant complications, including septic shock. Many children with MIS-C require hospitalization, including admission to the intensive care unit (ICU) and treatment with medication (e.g., IVIG; Mahmoud et al., 2022).

Neurocognitive Impact of MIS-C

In youth with MIS-C, the brain is also vulnerable to inflammation, which can lead to severe neurological injuries (e.g., stroke, seizures, encephalitis; Schober et al., 2021). In one recent pediatric cohort of youth with MIS-C presenting with neurologic symptoms, acute encephalitis syndrome was documented in over 47%, acute flaccid paralysis in over

26%, and stroke in over 21% (Rastogi et al., 2022). Fortunately, most children with MIS-C physically recover, but the long-term sequelae and neurological implications are unclear. Multiple reviews on MIS-C report rates of neurologic involvement ranging from 23 to 34% with the meningeal signs, headaches, confusion, and mood changes as most commonly observed features (Alcamo et al., 2021; Mavrogeni et al., 2021).

Less is known about the broader neuropsychological outcomes following recovery from MIS-C. Enner and colleagues (Enner et al., 2022) examined neuropsychiatric outcomes in patients admitted to the hospital with MIS-C compared to children hospitalized in the ICU with non-COVID-related illnesses. Parents completed ratings of their child's functioning before the pandemic, at the time of hospitalization, and around 20 weeks after discharge. Not surprisingly, parents reported high levels of neurological, psychiatric, and sleep issues during the hospitalization and relatively low levels of pre-illness issues. At follow-up, nearly half of children with MIS-C continued to have neurologic, psychiatric, and/or sleep symptoms. When compared to the control group, children with MIS-C endorsed significantly higher levels of symptoms during their hospitalization and at follow-up, but not pre-pandemic.

Similarly, Gosar and colleagues (Gosar et al., 2022) completed a follow-up study of children in Slovenia hospitalized with MIS-C and found that most children were doing quite well several months after their illness. Indeed, they did not identify impairments in intelligence testing (after accounting for parent education and pre-illness learning problems). However, they found that a substantial minority of children had difficulties on tests of other cognitive domains at 6 months post-illness, defined as scoring less than 1 standard deviation below the normative average. Specifically, attention (28%), executive functions (28%), and visual memory (35%) were impacted in about one-third of patients. Parents also reported mildly increased depression and attention problems.

Zuccotti and colleagues (Zuccotti et al., 2023) conducted a similar follow-up study examining outcomes in 33 children about 6 months following MIS-C. Again, at follow-up, while most children recovered and none showed impairments in nonverbal intelligence, a subset (around 30%) continued to report difficulties (e.g., problems with cognitive and academic functioning). Notably, a control group was not included in this study.

Overall, while current literature is extremely limited, emerging studies suggest that a sizable minority of children with a history of MIS-C may continue to experience cognitive difficulties several months post-diagnosis. While overall intelligence does not seem to be impacted, more subtle changes may be most commonly observed in higher level cognitive functions, such as attention, executive

functions, memory, emotional and behavioral functioning, and adaptive living skills, albeit the specific constellation of cognitive problems may vary with secondary neurological injuries like a stroke and onset of seizures. The neurodevelopmental ramifications of MIS-C in youth have been identified as a critical knowledge gap (Singer et al., 2021). More studies examining this rare but vulnerable population are needed.

Children with Long COVID

Prevalence of Long COVID

As mentioned above, a portion of children and adolescents report new or lingering symptoms weeks to months after COVID illness, many of whom were only mildly ill acutely. For many reasons, estimating the prevalence of long COVID in children has been very difficult, and prevalence rates vary significantly across studies. This likely stems from multiple factors including variability in long COVID definitions used and the time frames and populations, the nonspecific nature of many of the symptoms which overlap with many other conditions, lack of control groups, and high level of symptoms in the general population, biased samples, variable exclusion criteria, and others. Race and ethnicity data is also often not reported in studies and reviews, making it more difficult to judge the generalizability of findings.

Overall, estimated prevalence rates of long COVID have shifted somewhat since the start of the pandemic, with more recent reviews and studies suggesting lower prevalence rates. Zimmerman and colleagues completed reviews in 2021 and 2022. Their first review of 14 pediatric studies across 2020 and 2021 estimated the prevalence of long COVID symptoms as ranging from 4 to 66%, with 2 of 5 studies with controls not showing a significant difference in symptom prevalence between the COVID group and controls. Their second review of 27 studies from 2020 to 2022 found prevalence rates ranging from < 4 to 58% (Zimmermann et al., 2022). Studies comparing prevalence rates to controls found a difference of – 0.5% to 13%, with methodological limitations to many studies.

Lopez-Leon et al., 2022 systematic review and meta-analysis estimated 25% of children and adolescents as having persistent symptoms 4 or more weeks after infection. More recently, Zheng et al. (2023) examined the pooled estimated prevalence of long COVID in pediatric patients across 40 studies. The estimated pooled prevalence of long COVID symptoms was about 24%, with reduced prevalence rates with longer time since infection (3–6 months post-infection was 26%, 6–12 months was 21%, > 12 months was 15%).

Neurocognitive Impact of Pediatric Long COVID

Cognitive difficulties are one of the most frequently reported long COVID symptoms. More specifically, patients often report concentration difficulties, brain fog, forgetfulness, and other issues which impact their ability to function in school and daily life. Indeed, whether due to these symptoms, physical symptoms, or other issues, many children with long COVID are not attending school or are attending with less than a full schedule (Gonzalez-Aumatell et al., 2022). Multiple pathways and etiologies underly prolonged symptoms and cognitive difficulties even in youth with mild acute symptoms. In addition, even within the same child, different etiologies may underly different symptoms. Some children, for example, present with symptoms similar to myalgic encephalomyelitis/chronic fatigue, orthostatic intolerance, or other issues. Mood symptoms can also play a role in cognitive functioning. Attention—which is very susceptible to the effects of mood, anxiety, fatigue, pain, and other physical symptoms—can secondarily affect learning and memory.

Subjective Cognitive Impairment in Pediatric Long COVID

While cognitive difficulties are a commonly reported feature of long COVID, the observed prevalence rates drastically vary. In addition, most studies to date on long COVID in youth have used subjective ratings by either parents or children, rather than objective measures, and studies vary widely in the way this information was collected and definitions used.

Recent research suggests 3–6% of children and adolescents with a history of symptomatic COVID infection report lingering cognitive difficulties (Lopez-Leon et al., 2022; Hanson et al., 2022). Many studies report non-specific cognitive deficits such as “cognitive difficulties” (3%, Behnood et al., 2022; 6% Lopez-Leon et al., 2022), “brain fog” (30–40% in adolescents, Tarantino et al., 2022), “confusion” (3–7%, Molteni et al., 2021), or mixed functions such as “remembering and concentrating” (about 5–6% in Berg et al., 2022). When looking at specific domains, based on subjective informant reports, the most common cognitive domains affected in youth with long COVID include memory (about 40% in their adolescent sample; Tarantino, 2022; 45%, Buonsenso et al., 2022), attention (4 out of 5 in a case series, Luvigsson, 2020), concentration (2%, Radtke et al., 2021; 4%, Fink et al., 2021; 9%, Ashkenazi-Hoffnung et al., 2021; 10%, Buonsenso et al., 2021; 45%, Brackel et al., 2021; 61%, Buonsenso et al., 2022), speed of processing information (33%, Buonsenso et al., 2022), and short-term memory (33%, Buonsenso et al., 2022).

In some studies, subjective cognitive complaints have been associated with higher reported mood concerns (e.g.,

high rates of reported brain fog or attention problems were associated with higher levels of depression, anxiety, and post-traumatic stress; Tarantino et al., 2022). Furthermore, as mentioned above, in Zimmermann et al., 2021 review, 2 of 5 studies with controls did not find more symptoms in those with COVID infection history. Findings highlight the challenges in discerning symptoms attributed to the infection itself, the effects of the pandemic and mood changes, and/or the interaction of factors.

Regarding risk factors for reported cognitive difficulties in pediatric long COVID, some studies indicate that older children and adolescents are more at risk compared to younger children (Hoang et al., 2020). However, this might be due to the fact that older children and adolescents can more easily self-report symptoms, and symptoms are often more easily observed given the increased school demands. Some studies show that children with pre-existing conditions, like ADHD, may be at increased risk of long COVID cognitive difficulties (Merzon et al., 2022). Those with long COVID and acute hospitalization also appear to present with longer symptom duration, including cognitive difficulties, than those without hospitalization (Zimmermann et al., 2021; Frolli et al., 2021).

Among the limited longitudinal studies available, cognitive effects in youth with long COVID appear to diminish over time. As reviewed in Zimmerman et al. (2021), most symptoms among children with long COVID have resolved by 8 weeks. Likewise, cognitive complaints in children with long COVID were more likely to be transient such that these no longer differed from controls by 2 years post-infection (Taquet, 2022), with a gradual reduction in symptoms over time (Berg et al., 2022). Overall, prevalence rates of subjective cognitive difficulties vary widely from very few to almost half, and there are likely many factors contributing to these difficulties. It is anticipated that day-to-day difficulties with cognitive difficulties should gradually improve.

Findings on Objective Cognitive Impairment in Children

To date, very few studies have used objective cognitive testing in children with long COVID. Prevalence of impairments on testing varies widely, and most are finding a very high prevalence of comorbid depression and anxiety symptoms as well as fatigue. Most patients were presenting to specialty clinics and so represent a biased sample.

Ng et al. (2022) conducted a retrospective chart review based on the initial cohort of patients referred for neuropsychology consult from a multidisciplinary post-COVID clinic ($N=18$). Subjective reports of attention problems (83%) and depression/anxiety (80–93%) were very common; however, many children had pre-existing histories of attention (50%) and mood difficulties (72%) before COVID infection. On

objective testing, the majority of patients performed within the broadly average range across most cognitive domains with the exception of sustained auditory attention where a little over half of the sample performed below the average range (<16 th percentile). Eighteen percent of the sample performed below the average range on phonemic fluency. However, it should be noted that 77% of the sample tested via telehealth which is a novel model of care in pediatric neuropsychological service delivery and thus have less empirical support for use across clinical samples.

Recently, Gonzalex-Aumatell et al. (2022) reported test findings from 30 children/adolescents who were seen at a long COVID clinic. Their clinical sample showed most impairment in sustained attention (63%) followed by executive function (53%), processing speed (30%), and working memory (30%). Finally, another prospective investigation that tested adolescents 3–6 months after infection ($N=31$) reported the most common domain affected was verbal fluency (9–19% with low scores), followed by learning and memory (13%; Tarantino et al., 2022). In contrast to findings from Ng et al. and Gonzalez-Aumatell, these authors did not find significant deficits on attention measures, possibly because they only included measures of attention span and not sustained attention.

Overall, there are very few studies so far using cognitive testing with children with long COVID. The few that have been done have looked at mostly non-hospitalized youth at hospital clinics or specialty COVID clinics, so likely represent a biased sample of more impacted patients. There was also no pandemic control group, and only one study included validity testing (Ng et al., 2022). These initial studies are showing that attention and some executive functioning skills and possibly learning and memory might be impacted in some of these patients, but it is too early to draw conclusions from so few studies.

Clinical Recommendations

General recommendations for pediatric neuropsychologists working with children with long COVID are provided in Tables 1 and 2. These are not exhaustive lists and additional modifications may need to be considered depending on the specific child.

Summary and Future Directions

Despite variability in objective cognitive impairments in children with a history of COVID, many children are reporting everyday difficulties with thinking and academic performance. In our clinical experience, children and parents often report feeling as if their lives have been dramatically

Table 1 Information gathering

Information to Gather	Details
Detailed history	Family history, pregnancy/birth, development, medical, school, psycho-social, history of attention or learning concerns, etc.
Unique factors related to the pandemic	Reaction to the pandemic and related changes, lockdown measures, virtual school, reduced socialization), school modifications (when and if a child attended virtual school; engagement and progress during virtual school; availability of resources like special education services during virtual school; absenteeism; child's overall response
Acute COVID-19 infection and symptoms	Acute symptoms, test results, time out of school, and activities
Long COVID symptoms broadly and their timeline	Physical and sleep/fatigue-related symptoms (e.g., did initial acute symptoms resolve? When did various long COVID symptoms start and how have they changed over time? Which are most bothersome and how are they affecting them day-to-day? Description of pain and fatigue/sleep patterns and how they fluctuate and interact
Child's emotional, behavioral, and social functioning	Pre-pandemic, during the pandemic prior to infections, post-infection, any other life stressors around the time of infection and after
Current subjective cognitive complaints	With examples, and how these are impacting their home and school life
Current school functioning	Attendance, supports used, performance across different subjects, assistance offered by parents, etc.
Collateral information	Reports from caregivers, teachers, and interventionists. Interventionists or therapists who regularly see a child may have a keen sense of their fluctuating behavioral or cognitive challenges pre- vs. post-COVID-infection.

Table 2 Cognitive Testing for Children with COVID-19 and Long COVID

Areas to focus on:

- Attention (including more sustained attention)
- Working memory and executive functioning (including verbal fluency)
- Learning and memory
- Processing speed
- Performance validity
- Screening for mood and anxiety symptoms
- Ask about pain, fatigue, and other physical symptoms on day of testing

Other testing considerations:

- Cognitive testing can help identify relative strengths and weaknesses and can help inform recommendations for school and home
- Testing can help the patient and family understand subjective cognitive complaints (e.g., whether they have a memory deficit or attention problems are leading to forgetfulness).
- In most cases, children with long COVID do not need comprehensive neuropsychological test batteries and targeted testing is likely often sufficient. This is based on what we know about the neural effects of viral infections and autoimmune conditions and on the initial studies mentioned above. Areas such as intelligence, language, reading and math, and visuospatial functioning are not expected to be directly impacted by long COVID or hospitalization.
- If the patient has had known neurological injuries (e.g., stroke), assessments are tailored accordingly.
- When children have had evaluations before COVID infection or long COVID symptom onset, batteries can be tailored to directly compare test performance.
- Follow-up consultation with potential repeat testing (with alternate forms or tests as appropriate) can be completed to help track the child's recovery over time and provide updated recommendations.

altered following COVID infection. Neuropsychologists can help pinpoint the factors impacting a patient's cognitive and school functioning and provide recommendations for ways to improve these.

Notably, while the pandemic has been stressful for adults and children alike, the impact has often been particularly negative for children. Many children have experienced mental health decline, decreased socialization, school disruptions, loss of caregivers, poverty, and

reduced access to certain social and school-based services (Ravens-Sieberer et al., 2021). Educational disruption from the pandemic has been linked to reduced learning progress in children more broadly (Colvin et al., 2022). Certain groups, including children from historically disadvantaged groups, those with special needs/disabilities, and early learners, seem to be at the greatest risk for ongoing difficulties due to school disruptions (Colvin et al., 2022; Hawrilenko et al., 2021) which could in turn increase the risk for persistent emotional, behavioral, and cognitive difficulties.

Our current understanding of the impact of COVID-19, and particularly long COVID, is constrained by some of the abovementioned limitations of early COVID-19 research. It is imperative to address some of these limitations whenever possible to inform clinical care of youth with long COVID. For instance, researchers should aim to include comparison cohorts in their studies. Because the general pandemic environment has been stressful even in the absence of acute infection, thoughtful consideration should be given to the appropriateness of control group selection, which may include youth with asymptomatic infection and uncomplicated recovery and youth with MIS-C or other severe acute manifestation, but without long COVID. We note, however, that given the limitations in the availability of surveillance testing and the likelihood of considerable asymptomatic spread in youth, a child with no PCR-documented COVID-19 infection should *not* be assumed to never have had an undetected infection.

Second, researchers should rely on norm-referenced assessment measures whenever possible to allow for comparison not just to “control” groups, but also to normative, pre-pandemic expectation. This applies to ratings of mood and behavior, but particularly to measures of cognitive function, executive function, memory, processing speed, etc. Additionally, the inclusion of embedded and standalone measures of performance validity should be strongly considered. Notably, failure on performance validity measures has been associated with lower performance scores across a number of cognitive tests among children with developmental disabilities (Green & Flaro, 2021) and mild traumatic brain injury (Donders & Gardner, 2020), which yields many similar clinical symptoms as long COVID. Because of this, as well as the consensus of the field to use performance validity testing, it will be important to consider these as complementary to traditional cognitive measures and important to consider in interpreting assessment results and generating recommendations. Third, the use of measures in alignment with common data elements initiatives will allow for the integration of cross-site cohort studies and more rapidly lead to generalizable findings. Related, collaborative efforts will likely be most impactful both in designing research studies and working together to develop

a consensus statement on research and clinical cognitive test batteries for this population. Finally, given the variability in pandemic case rates and access to care for the management of long COVID, all possible effort should be made to include individuals from minoritized groups or those from regions with fewer socioeconomic advantages. This will help to drive conclusions that are more readily able to be disseminated to those most vulnerable.

In summary, children with long COVID often have many factors that contribute to cognitive difficulties. With expertise in brain-behavior relationships and training in clinical psychology, neuropsychologists are uniquely positioned to capture and synthesize the many factors that can impact cognitive functioning. Pediatric neuropsychologists can serve a key role in providing psychoeducation for patients, families, school personnel, and/or medical teams. They can help direct patients to appropriate clinical services and assist in developing school support plans and intervention planning, including compensatory strategies. With concerted efforts and coordinated care, children with long COVID may begin to show improvement in daily functioning and overall quality of life.

Declarations

Conflict of Interest The authors declare no competing interests.

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