

Exploring the Caregiver-Reported Impact of the COVID-19 Pandemic on Children with Traumatic Brain Injury

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ABSTRACT

The COVID-19 pandemic is expected to have a persistent, negative, and disproportionate impact on children with disabilities. Children with traumatic brain injury (TBI) may be expected to experience a disproportionate impact given the deficits often associated with childhood TBI (e.g., family functioning, fatigue, executive functioning, quality of life). This study aimed to explore the impact of the COVID-19 pandemic on children with TBI and their families, compared to typically developing (TD) children and their families. Thirty caregivers (TBI = 15; TD = 15) completed a series of electronic survey measures. Overall, caregivers reported no negative impact of the COVID-19 pandemic on their family's or child's functioning and association with demographic factors and domains of functioning showed no clear patterns. The findings of this exploratory study support continued longitudinal investigation with larger sample sizes of the provision of supports for all families and children in light of the COVID-19 pandemic. Additional research is needed to understand the effectiveness of targeted services for students with TBI in domains of functioning that are significantly poorer than TD children (e.g., quality of life, executive functioning, fatigue).

KEYWORDS: brain injury, COVID-19, executive functioning, fatigue, family, quality of life

Learning Outcomes: As a result of this activity, the reader will be able to:

- Describe the impact of the COVID-19 pandemic on family functioning, fatigue, executive functioning, and quality of life for children with TBI.
- Compare and contrast the impact of the COVID-19 pandemic on children with TBI and their TD peers.
- Describe opportunities for universal supports and services to reduce the impact of the COVID-19 pandemic on children with TBI and their TD peers.

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Children with traumatic brain injuries (TBIs) represent a subset of school-aged children with disabilities who, along with their families, might be disproportionately impacted by the COVID-19 pandemic (Aishworiya & Kang 2021; Goverover et al. 2022; Houtrow et al. 2020). The significant disruptions caused by the COVID-19 pandemic, including changes to daily routines, school delivery, and social opportunities, could have exacerbated injury-related difficulties for children with TBI (e.g., executive functioning, fatigue) and their families (e.g., overall functioning, parental stress; Fong & Iarocci 2020; Gazica et al. 2022; Gupta & Jawanda 2020). After experiencing a TBI of any severity, children and their families can experience chronic challenges in various domains of functioning across academic, social, and family settings that might impact their ability to positively adapt to and function during the COVID-19 pandemic disruptions (Anderson et al. 2009; Arnett et al. 2013; Fong & Iarocci 2020; Gazica et al. 2022; Gupta & Jawanda 2020; Petranovich et al. 2020; Treble-Barna et al. 2017).

Children with TBI tend to experience significantly lower executive functioning and significantly greater levels of fatigue than typically-developing (TD) peers (Le Fur et al. 2020; Riccardi & Ciccia 2021; Treble-Barna et al. 2017). Deficits in executive functioning (e.g., attention, memory, organization) and fatigue in any domain (e.g., physical, sleep, cognitive) are associated with worse academic and social performance (Anderson et al. 2009; Treble-Barna et al. 2017; van Markus-Doornbosch et al. 2016). Challenges in executive functioning after childhood TBI have been associated with worse family functioning (Durber et al. 2017; Durish et al. 2018; Kurowski et al. 2011; Rashid et al. 2014). As families experience chronic changes in their child's functioning post-injury, caregivers and families often report family functioning that is significantly worse than families with children without TBI (de Kloet et al. 2015; Durber et al. 2017; McKee et al. 2020). Areas of family functioning might include caregiver stress, coping, family relationships, communication, and parent-provided stimulation for the child (Bradley et al. 2000; Jastrowski Mano et al. 2011). The often subtle

but chronic and complex needs of children with TBI are expected to contribute to greater caregiver burden, negatively impacting family functioning, and in-turn negatively impact other outcomes (Allonsius et al. 2021; LeBlond et al. 2021; McKee et al. 2020).

Challenges with fatigue, executive functioning, and family functioning, alongside other common areas of need, have been associated with lower quality of life for children with TBI compared to TD peers (Åkerlund et al. 2021; Anderson et al. 2009; Câmara-Costa et al. 2020; Cantor et al. 2008; de Kloet et al. 2015; Hypher et al. 2021; LeBlond et al. 2021). Quality of life post-injury is mediated by many injury, child, and family factors. Younger age at injury, more severe injuries, lower income, and non-White race have been associated with worse quality of life up in the acute and chronic stages of recovery after childhood TBI (Anderson et al. 2009, 2011; McCarthy et al. 2006; Yeates et al. 2002). Conversely, high family and community resources and the provision of supports and intervention have been shown to support positive long-term quality of life (LeBlond et al. 2021; Limond et al. 2009; McCarthy et al. 2006). These risk and resilience factors may play a critical role in predicting the acute and long-term impact of the COVID-19 pandemic for all children and particularly children with TBI (Du et al. 2021; Fong & Iarocci 2020; Ueda et al. 2021).

Although research is emerging, the COVID-19 pandemic is expected to exacerbate existing challenges for individuals with TBI and children with disabilities (Chandran & Alagesan 2021; Houtrow et al. 2020; Lipkin & Crepeau-Hobson 2022; Morrow et al. 2021). Changes in school delivery likely resulted in decreased academic supports, and, with social isolation, contributed to worse mental and emotional health for all children (Adibelli & Sümen 2020; Aishworiya & Kang 2021; Ehrler et al. 2021; Meade 2021; Styck et al. 2021; Zengin et al. 2021). With decreased structure and increased stressors, challenges with executive functioning and fatigue were likely amplified (Aishworiya & Kang 2021; Bates et al. 2020; Bryson 2021; Lipkin & Crepeau-Hobson 2022; Luijten et al. 2021; Morgul et al. 2021; Styck et al. 2021). Similarly, adapting to school

and work changes to support their children, caregiver burden likely increased, potentially contributing to a decrease in family functioning (Chandran & Alagesan 2021; Du et al. 2021; Ehrler et al. 2021; Magson et al. 2021; Meade 2021). Across all groups, quality of life might be decreased and might remain negatively impacted with continued COVID-19-related restrictions for academic, social, and work settings (Bryson 2021; Goverover et al. 2022). Critically, families of lower income, of non-White race, and with a child with a disability have been shown to be disproportionately impacted by the COVID-19 pandemic (Aishworiya & Kang 2021; Chandran & Alagesan 2021; Du et al. 2021; Fong & Iarocci 2020; Molloy & Bearer 2021; Tso et al. 2022; Warren & Bordoloi 2020). As described by Tso et al. (2022), children with special education needs and from single parent and low-income families were at a higher risk of psychosocial problems during the COVID-19 pandemic compared to peers in other groups.

Understanding children's and families' functioning during the COVID-19 pandemic is essential to inform educational and social supports that could reduce the negative long-term academic, social, and family impacts (Aishworiya & Kang 2021; Chandran & Alagesan 2021). In particular, investigating the functioning of children with TBI and their families is an important first step toward reducing the potentially disproportionate consequences of the COVID-19 pandemic. The purpose of this study was to explore the impact of the COVID-19 pandemic on children with TBI and their families, compared to TD children and their families. The research questions of this study included:

1. How did the COVID-19 pandemic impact the family functioning, quality of life, fatigue, and executive functioning of children with TBI and their families, compared to TD children and their families?
2. How did the COVID-19 pandemic impact family functioning, quality of life, fatigue, and executive functioning for children with TBI and TD children based on family income, race/ethnicity, and school delivery format?

It was hypothesized that the COVID-19 pandemic had a greater negative impact on the quality of life, fatigue, executive functioning, and family functioning of children with TBI and their families, compared to TD children and their families. Children of non-White ethnicity, of lower family income, and who were enrolled in remote or hybrid school delivery formats were expected to have lower scores on family functioning, quality of life, and fatigue and higher executive functioning scores during the COVID-19 pandemic, representing poorer functioning across domains. Differences were expected to be more pronounced in children with TBI than TD children.

METHODS

Participants

Participants for this study included 30 caregivers who reported on 15 children with TBI and 15 TD children.

Procedure

Caregivers were recruited through social media postings (e.g., Reddit, Children Helping Science, Facebook, Twitter) that included a link directly to a screening questionnaire. Screening questions identified the eligibility of participants. Inclusion criteria were as follows: (1) caregiver of a child between 8 and 17 years old (i.e., school-aged) and (2) proficient in English as indicated by ability to complete the survey. For the TBI group, additional inclusion criteria were that the child experienced an accidental mild-complicated, moderate, or severe TBI after 6 months of age and was at least 6 months post-injury with persistent symptoms per parent-report of medical diagnosis. Exclusion criteria for the TD group was a history of cognitive, emotional, or learning disability or receipt of special education services at school. If the caregiver met the eligibility criteria to participate, they were provided further information about the study and completed consent procedures in accordance with the university's institutional review board. Then, caregivers were directed to complete the survey.

Caregivers participated in the study by completing a survey in REDCAP (Research

Table 1 COVID-19-related questions

Question	Response options
Has your child tested positive for COVID-19?	Yes No
Choose the option that best describes your child's current school delivery method	In-person only Remote only Hybrid
Thinking about March 2020 until now (the time period when COVID pandemic has affected the greater community), how do you think your family functioning has changed? ^a	Decreased (worse) family functioning Same level family functioning Increased (better) family functioning
Thinking about March 2020 until now (the time period when COVID pandemic has affected the greater community), how do you think your child's behaviors and executive functions have changed? ^a	Decreased behavioral concerns Same level of behavioral concerns Increased behavioral concerns
Thinking about March 2020 until now (the time period when COVID pandemic has affected the greater community), how do you think your child's fatigue has changed? ^a	Decreased (less) fatigue Same level fatigue Increased (more) fatigue
Thinking about March 2020 until now (the time period when COVID pandemic has affected the greater community), how do you think your child's quality of life (physical, social, emotional, and school functioning) has changed? ^a	Decreased (worse) quality of life Same level quality of life Increased (better) quality of life

^aResults of these questions were used to answer the second research question.

Electronic Data Capture; Harris et al. 2009, 2019) between October 2020 and October 2021. The survey took about 30 minutes to complete and included five sections. The first section included demographic information. The second through fourth sections included measures of family functioning, executive functioning, fatigue, and quality of life. Finally, a series of questions related to the COVID-19 pandemic and developed for this study were included throughout. These questions are shown in Table 1. These last four questions in this table were used to answer the second research question of the current study.

Measures

All measures included in this study were completed electronically by caregivers. Caregivers answered demographic questions, including child's age, child's sex, child's race/ethnicity, family income, and, for children with TBI, injury severity and date of injury. Child's race/ethnicity was dichotomized to include (1) White/non-Hispanic and (2) non-White (i.e., African American, Latino/Hispanic, Native American). Time since injury was calculat-

ed after the survey based on date of injury and date of survey completion.

The four measures included as part of the survey are described in the following, including the purpose, procedures, scoring, and psychometrics.

1. Family functioning was measured using the McMaster Family Assessment Device (general functioning subscale short version; FAD; Epstein et al. 1983). The FAD includes 12 items rated on a four-point Likert scale addressing the overall health of the family. Total scores range from 1.0 (best functioning) to 4.0 (worst functioning), with scores greater than 2 indicating problematic family functioning. The FAD short version has shown good internal reliability and validity (Botelho de Haan et al. 2015).
2. Child's executive functioning was measured using the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2)—Parent-Report (Gioia et al. 2015). The BRIEF-2 Parent-Report includes 63 items rated on a three-point Likert scale addressing aspects of behavior representing executive functioning (e.g., ability to

control impulses, modulate responses). The General Executive Composite (GEC) score is a scaled summary *t*-score representing overall executive functioning, where scores of 60 or more indicate elevated levels of executive dysfunction. The BRIEF-2 has shown good construct validity and internal consistency (Viola et al. 2017).

3. Child's fatigue was measured using the Pediatric Quality of Life Inventory Multidimensional Fatigue Scale (PedsQL MFS)—Parent-Report (Varni 1998b). The PedsQL MFS includes 18 items rated on a five-point Likert scale measuring general, sleep/rest, and cognitive fatigue. Scores range from 0 to 100, with higher scores indicating less fatigue. The PedsQL MFS has shown good internal consistency reliability, test-retest reliability, and interobserver reliability (Gordijn et al. 2011).
4. Child's quality of life was measured using the Pediatric Quality of Life Inventory Generic Core Scale (PedsQL GCS)—Parent-Report (Varni 1998a). The PedsQL GCS includes 23-items rated on a five-point Likert scale measuring quality of life related to physical, emotional, social, and school functioning. Scores range from 0 to 100, with higher scores indicating higher quality of life. The PedsQL GCS has shown good internal consistency reliability, construct validity, and interobserver reliability (Varni et al. 2001).

Distributed throughout the survey, caregivers answered questions related to the COVID-19 pandemic, listed in Table 1 with response options. These questions were included to better understand the child's experiences during the COVID-19 pandemic (e.g., school delivery format), and changes to the child's functioning during the COVID-19 pandemic. These questions were developed for this specific study to answer the second research question; therefore, psychometrics are not available.

Data Analysis

Measures were scored as indicated by the measure's manual or guidelines. Fatigue, executive functioning, family functioning, and quality of life were reported as continuous variables

and averaged for each group (i.e., TBI, TD). For questions related to the COVID-19 pandemic, Likert response options for changes in child's fatigue, and executive functioning due to the COVID-19 pandemic were transformed to align with family functioning and child's quality of life, such that lower Likert ratings represented negative changes or worse functioning due to the COVID-19 pandemic. Then, Likert response options were aggregated as frequencies for each response option and presented separately for each group (i.e., TBI, TD).

Descriptive statistics were calculated for all study variables. For demographic variables, groups were compared using chi-square analyses for categorical outcome variables (i.e., sex, race/ethnicity, income, school delivery formats), independent samples *t*-tests for continuous outcome variables (i.e., age, family functioning, quality of life), and Mann-Whitney *U*-tests for continuous outcome variables that violate the assumption of equal variance through Levene's test (i.e., fatigue, executive functioning). For both exploratory research questions related to the impact of the COVID-19 pandemic, the relationship between groups (i.e., TBI, TD) was analyzed using chi-square analyses given the level of measurement (i.e., Likert ratings of "worse," "same," or "better" functioning during the COVID-19 pandemic). For the first exploratory research question, the average Likert ratings related to the impact of the COVID-19 pandemic on different areas of functioning were compared between children with TBI and TD children. For the second exploratory research question, the frequency of the Likert rating response options related to the impact of the COVID-19 pandemic on different areas of functioning was compared based on categorical demographic characteristics (i.e., family income, race/ethnicity, school delivery format). Children with TBI and TD children were analyzed separately. Results were considered statistically significant when $p < 0.05$. All analyses were conducted using JASP 0.16.1 (JASP Team 2023).

RESULTS

Participant Characteristics

Descriptive statistics are reported by group (i.e., TBI vs. TD) in Table 2. Children were, on

Table 2 Demographic characteristics by group (N = 30)

Variable	TBI group (n = 15)	TD group (n = 15)
Age (M (SD))	10.06 (1.59)	10.53 (1.91)
Sex (% male (n))	60.00% (9)	53.33% (8)
Race/Ethnicity		
White, non-Hispanic	66.67% (10)	86.66% (13)
Non-White ^a	33.33% (5)	13.33% (2)
Family income (% (n))		
\$26,000–50,000	6.67% (1)	0
\$51,000–75,000	33.33% (5)	0
\$76,000–100,000	53.33% (8)	13.33% (2)
\$101,000–150,000	0	20.00% (3)
Greater than \$150,000	6.67% (1)	66.67% (10)
Family functioning (M (SD))	1.69 (1.75)	1.50 (1.25)
Quality of life (M (SD)) ^b	55.80 (11.01)	85.94 (9.23)
Fatigue (M (SD)) ^b	55.46 (15.95)	84.91 (9.61)
Executive functioning (M (SD)) ^b	57.40 (9.26)	45.87 (7.92)
Positive for COVID-19 test	0	0
Suspected COVID-19 (not tested)	0	0
School delivery format (% (n))		
In-person only	60.00% (9)	53.33% (8)
Remote only	40.00% (6)	33.33% (5)
Hybrid	0	13.33% (2)

^aNon-White included: African American, Latino/Hispanic, Native American.

^bSignificant differences by group ($p < 0.001$).

average, 10 years old at the time of survey completion. Both groups had slightly more males than females and were predominantly White/non-Hispanic. As listed in Table 2, groups (i.e., TBI, TD) did not differ significantly in the following demographic domains: age (about 10 years old; $t(28) = 0.74$, $p = 0.467$), sex (57% male; $\chi^2(1, 30) = 0.14$, $p = 0.713$), race/ethnicity (77% White; $\chi^2(1, 30) = 1.68$, $p = 0.195$), and family functioning as measured by the FAD (rated as “nonproblematic”; $t(28) = -1.22$, $p = 0.233$). There was a significant difference in family income, with families of children with TBI earning significantly less than families of TD children, $\chi^2(4, 30) = 19.96$, $p < 0.001$. Children in the TBI group were, on average, injured at 4.69 years old ($SD = 1.53$ years, range = 2.85–9.44) and currently 5.37 years post-injury ($SD = 1.53$ years, range = 3.03–9.86). Most children experienced a severe TBI (80.00%, $n = 12$), while three children experienced moderate severity TBIs (20.00%).

No children in either group had a positive or suspected case of COVID-19. School delivery format did not differ significantly by group, with most children participating in in-person school programming, $\chi^2(2, 30) = 2.15$, $p = 0.341$. Children with TBI were reported to have significantly poorer functioning than TD children for quality of life, $t(28) = 8.13$, $p < 0.001$, fatigue, $W = 37.00$, $p = 0.002$, and executive functioning, $W = 37.00$, $p = 0.002$.

Impacts of the COVID-19 Pandemic

In the domains of family functioning, fatigue, and executive functioning, both groups most often reported the same or better functioning during the COVID-19 pandemic. There were no significant differences in distribution of scores between groups (i.e., TBI, TD) for the impact of COVID-19 pandemic on family functioning, $\chi^2(2, 30) = 1.05$, $p = 0.592$ (see Fig. 1), fatigue, $\chi^2(2, 30) = 1.04$, $p = 0.595$ (see Fig. 2), or executive functioning, $\chi^2(2, 30) = 5.09$, $p = 0.079$ (see Fig. 3). TD children were more likely to have poorer quality of life during the COVID-19 pandemic compared to children with TBI who were most likely to have a stable quality of life, $\chi^2(2, 30) = 7.04$, $p = 0.030$ (see Fig. 4).

When analyzing the impacts of the COVID-19 pandemic based on income, race/ethnicity, and school delivery format for children with TBI and TD children separately, only two results were significant. For children with TBI, changes in fatigue due to the COVID-19 pandemic were different based on family

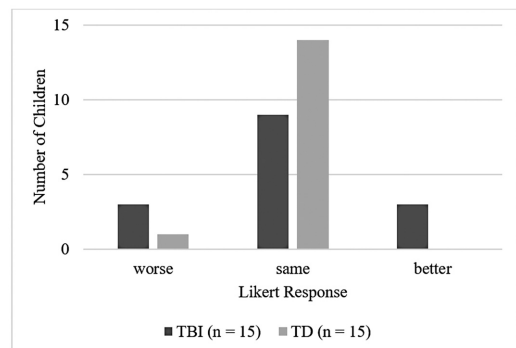


Figure 1 COVID-19 impact on family functioning by injury group (N = 30).

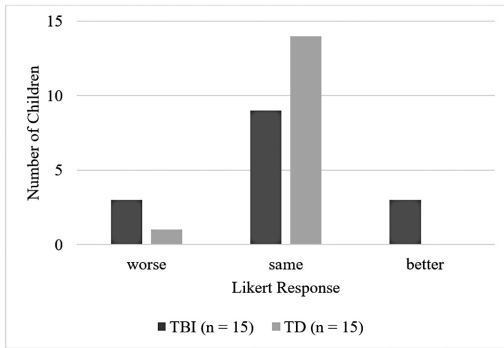


Figure 2 COVID-19 impact on fatigue by injury group (*n* = 30).

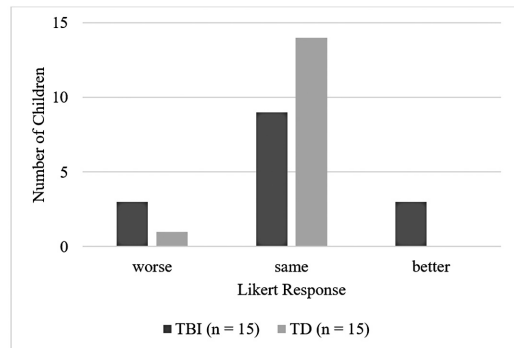


Figure 4 COVID-19 impact on quality of life by injury group (*n* = 30).

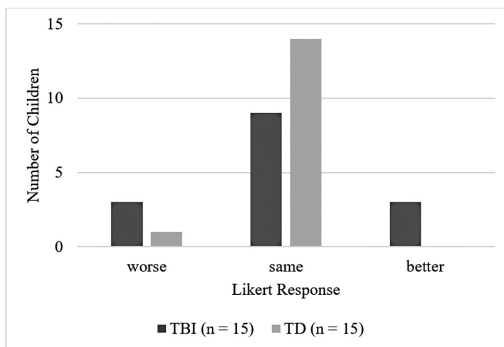


Figure 3 COVID-19 impact on executive functioning by injury group (*n* = 30).

income, $\chi^2(6, 15) = 23.00, p < 0.001$. Children with TBI of higher income reported significantly more frequency of stable or less fatigue compared to children with TBI of lower income. For TD children, changes in executive functioning due to the COVID-19 pandemic were different based on race/ethnicity, $\chi^2(1, 15) = 6.96, p = 0.008$. White/non-Hispanic TD children reported significantly more frequency of stable functioning when compared to non-White TD children.

DISCUSSION

Although the COVID-19 pandemic is anticipated to have disproportionately negative effects on children with disabilities, research is just emerging on the patterns and factors influencing functioning months and years into the COVID-19 pandemic. The present explor-

atory study begins to highlight how the COVID-19 pandemic impacted children with moderate to severe TBI. While some of the results were unexpected, these exploratory findings provide opportunities for continued research and early ideas on how to support children and their families, including those with TBI, in the wake of the COVID-19 pandemic.

There were no significant differences in the impact of the COVID-19 pandemic on fatigue, executive functioning, or family functioning for children with TBI compared to TD children. These findings were unexpected based on trends in research studies conducted during earlier times of the COVID-19 pandemic (Chandran & Alagesan 2021; Houtrow et al. 2020; Lipkin & Crepeau-Hobson 2022; Morrow et al. 2021). Furthermore, these results could be influenced by the larger time frame of data collection (i.e., beginning about 6 months after the start of the COVID-19 pandemic and continuing for 1 year), in which COVID-19-related restrictions were likely changing (e.g., school delivery formats), or by the design of survey measures. Families might not have been familiar with the terms used in the survey questions (e.g., “executive functioning”), limiting their ability to accurately report changes in this domain.

Overall, domains were reported to have remained stable (i.e., “same” level of functioning) for most children in both groups (i.e., TBI, TD) during the COVID-19 pandemic, except for a reported negative impact on quality of life

of TD children. Interestingly, this pattern was not consistent for children with TBI, despite their quality-of-life scores being significantly lower compared to TD children. This finding could reflect the positive family functioning of this group, possibly making these families more adaptable to the changes associated with the COVID-19 pandemic (e.g., modified school schedules; decreased social engagements; [Fereidouni et al. 2021; Spina et al. 2005; Ueda et al. 2021]). Additionally, this finding could be reflective of the lower quality of life of children with TBI pre-pandemic. Some changes associated with the pandemic (e.g., fewer social interactions) might mirror pre-pandemic life for children with TBI and their families (Morrow et al. 2021).

Surprisingly, demographic and school-related factors were not consistently associated with reported COVID-19 pandemic-related changes in functioning for either group. Differences in executive functioning for the TD group based on race/ethnicity and in fatigue for the TBI group based on family income were the only significant findings. Potential relationships based on race/ethnicity, income, or school delivery format were likely not detected given the small and relatively homogeneous sample.

Clinical Implications

Practitioners might consider addressing COVID-19-related changes and needs through universal supports for children and families. When experiencing the effects of large-scale and potentially traumatic events, like the COVID-19 pandemic, professionals might aim to strengthen families' already-established strategies and developing new strategies of resilience (e.g., family relationship building, social supports, faith-based practices; Gayatri & Irawaty 2022). Universal supports for all children and families might be an efficient use of staff time and resources. Further research on predictors of functioning after childhood TBI generally, and particularly when considering the COVID-19 pandemic, would support identifying families in need of more individualized supports. Given the significant association of non-White race/ethnicity

and lower income with poorer executive functioning for TD children and greater fatigue for children with TBI, respectively, professionals, including speech-language pathologists, might consider more targeted supports and interventions to historically marginalized families.

When considering supports and services specifically for children with TBI post-COVID-19 pandemic, the findings of this study highlight the need for an interdisciplinary approach among professionals and families. With the exception of family functioning, all other domains of functioning (i.e., quality of life, fatigue, executive functioning) were significantly poorer for children with TBI compared to TD children. Given the expected long-term impacts of the COVID-19 pandemic, the domains of quality of life, fatigue, and executive functioning might need targeted attention from providers. With a family-centered, collaborative approach, professionals could target multiple areas of functioning, building on existing strengths in family functioning, to encourage better outcomes for children with TBI. In addition to caregivers and the child, schools should consider including speech-language pathologists, social workers/counselors, and nurses on teams serving students with TBI. These professionals demonstrate unique expertise in areas of functioning in deficit and are already present in the school setting to serve children with moderate-severe TBI (Salley et al. 2019). For example, social workers/counselors could facilitate connecting families to resources that might improve the quality of life, while speech-language pathologists could provide direct services to improve a child's executive functioning, which might also contribute to a better quality of life. Together, these professionals can provide individualized supports and services to comprehensively address the child and family's needs, in light of their own risk and protective factors, to improve their functioning after TBI.

Limitations and Future Directions

Although this study was exploratory, data collection and statistical methods pose additional limitations to the findings and opportunities for future research. The cross-sectional nature of

this study; the use of short, caregiver-rating questions to determine the impact of the COVID-19 pandemic; and the time frame of data collection could have influenced caregivers' reports to show less of a negative impact of the COVID-19 pandemic, compared to previous findings. With a small sample size and group differences in income, differences between children with TBI and TD children might not reflect patterns of the larger populations. Significant differences in income by group (i.e., TBI of lower income) and the mostly White/non-Hispanic race/ethnicity of the entire sample likely skewed the research findings. Future research is needed with larger and more diverse samples to better elucidate these relationships.

Furthermore, many statistical analyses were conducted to explore relationships, increasing the likelihood of Type 1 errors or false-positive results. Given the exploratory nature of this study, correcting for multiple comparison was not deemed necessary and the number of analyses were retained to provide preliminary evidence for future studies. Investigators could use these exploratory findings to prioritize domains of investigation and statistical approaches. Longitudinal investigation with a larger, matched groups is needed to understand the long-term consequences of child and family factors associated with positive functioning after the COVID-19 pandemic. Future studies should consider using more robust statistical methods with greater statistical power, controlling for multiple comparisons. Further qualitative research with children and parents might also provide unique insights on patterns of functioning and strategies for minimizing the impact of the COVID-19 pandemic. Particularly, mixed-methods research on family resilience during and following the pandemic would likely inform medical and educational supports and services.

CONCLUSIONS

This exploratory study identified emerging patterns in child and family functioning during the continued COVID-19 pandemic. Across most domains of functioning, children with TBI and TD children and their families appear to demonstrate resilience to the expected negative

impacts of the COVID-19 pandemic. Professionals should consider an interdisciplinary approach to continuing the resilient responses of these families, while focusing on providing supports and services that could improve outcomes for children with TBI in the domains of quality of life, fatigue, and executive functioning. Future research can build upon these initial findings to clarify patterns of functioning in light of the COVID-19 pandemic based on demographic factors to better inform supports and services for all children and their families and particularly those with TBI.

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REFERENCES

- Adibelli D & Sümen, A. (2020). The effect of the coronavirus (COVID-19) pandemic on health-related quality of life in children. *Children and Youth Services Review* 119:105595
- Aishworiya R & Kang, Y. Q. (2021). Including children with developmental disabilities in the equation during this COVID-19 Pandemic. *Journal of Autism and Developmental Disorders* 51(06):2155–2158
- Åkerlund E, Sunnerhagen KS & Persson, H. C. (2021). Fatigue after acquired brain injury impacts health-related quality of life: an exploratory cohort study. *Scientific Reports* 11(01):22153
- Allonsius F, De Kloet AJ, Van Markus-Doornbosch F, Meesters JJ. L, Kromme CH, Vliet Vlieland TP. M & Van Der Holst, M. (2021). Parent-reported family impact in children and young adults with acquired brain injury in the outpatient rehabilitation setting. *Brain Injury : [BI]* 35(05):563–573
- Anderson V, Brown S, Newitt H & Hoile, H. (2009). Educational, vocational, psychosocial, and quality-of-life outcomes for adult survivors of childhood traumatic brain injury. *The Journal of Head Trauma Rehabilitation* 24(05):303–312

- Anderson V, Brown S, Newitt H & Hoile, H. (2011). Long-term outcome from childhood traumatic brain injury: intellectual ability, personality, and quality of life. *Neuropsychology* 25(02):176–184
- Arnett AB, Peterson RL, Kirkwood MW, Taylor HG, Stancin T, Brown TM & Wade, S. L. (2013). Behavioral and cognitive predictors of educational outcomes in pediatric traumatic brain injury. *Journal of the International Neuropsychological Society* 19(08):881–889
- Bates LC, Zieff G, Stanford K, Moore JB, Kerr ZY, Hanson ED, Barone Gibbs B, Kline CE & Stoner, L. (2020). COVID-19 impact on behaviors across the 24-hour day in children and adolescents: physical activity, sedentary behavior, and sleep. *Children (Basel, Switzerland)* 7(09):9
- Boterhoven de Haan KL, Hafekost J, Lawrence D, Sawyer MG, Zubrick SR (2015). Reliability and validity of a short version of the general functioning subscale of the McMaster Family Assessment Device. *Family Process* 54(01):116–123
- Bradley RH, Corwyn RF, Caldwell BM, Whiteside-Mansell L, Wasserman GA & Mink, I. T. (2000). Measuring the home environments of children in early adolescence. *Journal of Research on Adolescence* 10(03):3
- Bryson WJ (2021). Long-term health-related quality of life concerns related to the COVID-19 pandemic: a call to action. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation* 30(03):643–645
- Câmara-Costa H, Opatowski M, Francillette L, Toure H, Brugel D, Laurent-Vannier A, Meyer P, Watier L, Dellatolas G & Cheignard, M. (2020). Self- and parent-reported Quality of Life 7 years after severe childhood traumatic brain injury in the Traumatisme Grave de l'Enfant cohort: associations with objective and subjective factors and outcomes. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation* 29(02):515–528
- Cantor JB, Ashman T, Gordon W, Ginsberg A, Engmann C, Egan M, Spielman L, Dijkers M & Flanagan, S. (2008). Fatigue after traumatic brain injury and its impact on participation and quality of life. *The Journal of Head Trauma Rehabilitation* 23(01):41–51
- Chandran R & Alagesan, J. (2021). Impact of COVID-19 on caregiver burden among parents of differently abled children: a survey. *INTI Journal* 4:1–7
- de Kloet AJ, Lambregts SA. M, Berger MA. M, van Markus F, Wolterbeek R & Vliet Vlieland, T. P. M. (2015). Family impact of acquired brain injury in children and youth. *Journal of Developmental and Behavioral Pediatrics* 36(05):342–351
- Du F, He L, Francis MR, Forshaw M, Woolfall K, Lv Q, Shi L & Hou, Z. (2021). Associations between parent-child relationship, and children's externalizing and internalizing symptoms, and lifestyle behaviors in China during the COVID-19 epidemic. *Scientific Reports* 11(01):23375
- Durber CM, Yeates KO, Taylor HG, Walz NC, Stancin T & Wade, S. L. (2017). The family environment predicts long-term academic achievement and classroom behavior following traumatic brain injury in early childhood. *Neuropsychology* 31(05):499–507
- Durish CL, Yeates KO, Stancin T, Taylor HG, Walz NC & Wade, S. L. (2018). Home environment as a predictor of long-term executive functioning following early childhood traumatic brain injury. *Journal of the International Neuropsychological Society* 24(01):11–21
- Ehrler M, Werninger I, Schnider B, Eichelberger DA, Naef N, Disselhoff V, Kretschmar O, Hagmann CF, Latal B & Wehrle, F. M. (2021). Impact of the COVID-19 pandemic on children with and without risk for neurodevelopmental impairments. *Acta Paediatrica (Oslo, Norway)* 110(04):1281–1288
- Epstein NB, Baldwin LM & Bishop, D. S. (1983). The McMaster family assessment device. *Journal of Marital and Family Therapy* 9(02):171–180
- Fereidouni Z, Kamyab AH, Dehghan A, Khiyali Z, Ziapour A, Mehedi N & Toghroli, R. (2021). A comparative study on the quality of life and resilience of mothers with disabled and neurotypically developing children in Iran. *Heliyon* 7(06):e07285
- Fong CV & Iarocci, G. (2020). Child and family outcomes following pandemics: A systematic review and recommendations on COVID-19 policies. *Journal of Pediatric Psychology* 45(10):1124–1143
- Gayatri M & Irawaty, D. K. (2022). Family resilience during COVID-19 pandemic: a literature review. *The Family Journal (Alexandria, Va.)* 30(02):132–138
- Gazia MW, Leto GD & Irish, A. L. (2022). The effects of unexpected changes to content delivery on student learning outcomes: a psychological contract perspective during the COVID-19 era. *Psychology in the Schools* 59(08):1473–1491
- Gioia GA, Isquith PK, Guy SC & Kenworthy, L. (2015). Behavior Rating Inventory of Executive Functioning (2nd ed.). PAR, Inc.
- Gordijn M, Cremers EM. P, Kaspers GJ. L & Gemke, R. J. B. J. (2011). Fatigue in children: reliability and validity of the Dutch PedsQL Multidimensional Fatigue Scale. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation* 20(07):1103–1108
- Goverover Y, Kim G, Chen MH, Volebel GT, Rosenfeld M, Botticello A, DeLuca J & Genova, H. M. (2022). The impact of the COVID-19 pandemic on engagement in activities of daily living in persons with acquired brain injury. *Brain Injury : [BI]* 36(02):183–190

- Gupta S & Jawanda, M. K. (2020). The impacts of COVID-19 on children. *Acta Paediatrica* (Oslo, Norway) 109(11):2181–2183
- Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, McLeod L, Delacqua G, Delacqua F, Kirby J, Duda SN & The REDCap Consortium. (2019). The REDCap consortium: building an international community of software platform partners. *Journal of Biomedical Informatics* 95:103208
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N & Conde, J. G. (2009). Research electronic data capture (REDCap) – a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics* 42(02):377–381
- Houtrow A, Harris D, Molinero A, Levin-Decanini T & Robichaud, C. (2020). Children with disabilities in the United States and the COVID-19 pandemic. *Journal of Pediatric Rehabilitation Medicine* 13:415–424
- Hypher R, Andersson S, Finnanger TG, Brandt AE, Hoorelbeke K, Lie HC, Barder HE, Larsen SM, Risnes K, Rø TB & Stubberud, J. (2021). Fatigue following pediatric acquired brain injury: Interplay with associated factors in a clinical trial population compared to healthy controls. *Neuropsychology* 35(06):609–621
- JASP Team. (2023). *JASP (Version 0.17)[Computer software]*
- Jastrowski Mano KE, Khan KA, Ladwig RJ & Weisman, S. J. (2011). The impact of pediatric chronic pain on parents' health-related quality of life and family functioning: Reliability and validity of the PedsQL 4.0 Family Impact Module. *Journal of Pediatric Psychology* 36(05):517–527
- Kurowski BG, Taylor HG, Yeates KO, Walz NC, Stancin T & Wade, S. L. (2011). Caregiver ratings of long-term executive dysfunction and attention problems after early childhood traumatic brain injury: family functioning is important. *PM & R* 3(09): 836–845
- Le Fur C, Câmara-Costa H, Francillette L, Opatowski M, Toure H, Brugel D, Laurent-Vannier A, Meyer P, Watier L, Dellatolas G & Chevnignard, M. (2020). Executive functions and attention 7 years after severe childhood traumatic brain injury: Results of the Traumatisme Grave de l'Enfant (TGE) cohort. *Annals of Physical and Rehabilitation Medicine* 63(04):270–279
- LeBlond E, Smith-Paine J, Narad M, Wade SL, Gardis M, Naresh M, Makoroff K & Rhine, T. (2021). Understanding the relationship between family functioning and health-related quality of life in very young children with moderate-to-severe TBI. *The Clinical Neuropsychologist* 35:868–884
- Limond J, Dorris L & McMillan, T. M. (2009). Quality of life in children with acquired brain injury: parent perspectives 1–5 years after injury. *Brain Injury* : [BI] 23(07):617–622
- Lipkin M & Crepeau-Hobson, F. (2022). The impact of the COVID-19 school closures on families with children with disabilities: a qualitative analysis. *Psychology in the Schools*. 1–16. Accessed June 12, 2023 at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9088372/>
- Luijten MA, J, van Muilekom MM, Teela L, Polderman TJ, C, Terwee CB, Zijlmans J, Klaufus L, Popma A, Oostrom KJ, van Oers HA & Haverman, L. (2021). The impact of lockdown during the COVID-19 pandemic on mental and social health of children and adolescents. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation* 30(10):2795–2804
- Magson NR, Freeman JY, A, Rapee RM, Richardson CE, Oar EL & Fardouly, J. (2021). Risk and protective factors for prospective changes in adolescent mental health during the COVID-19 pandemic. *Journal of Youth and Adolescence* 50(01):44–57
- McCarthy ML, MacKenzie EJ, Durbin DR, Aitken ME, Jaffe KM, Paidas CN, Slomine BS, Dorsch AM, Christensen JR, Ding R & The Children's Health After Trauma Study Group. (2006). Health-related quality of life during the first year after traumatic brain injury. *Archives of Pediatrics & Adolescent Medicine* 160(03):252–260
- McKee GB, Olabarrieta-Landa L, Pérez-Delgadillo PK, Valdivia-Tangarife R, Villaseñor-Cabrera T, Ramos-Usuga D, Perrin PB & Arango-Lasprilla, J. C. (2020). Longitudinal growth curve trajectories of family dynamics after pediatric traumatic brain injury in Mexico. *International Journal of Environmental Research and Public Health* 17(22):22
- Meade J (2021). Mental health effects of the COVID-19 pandemic on children and adolescents. *Pediatric Clinics of North America* 68(05):945–959
- Molloy EJ & Bearer, C. B. (2021). Pediatric research and COVID-19: the changed landscape. *Pediatric Research* 92:618–619. Doi: 10.1038/s41390-021-01857-0
- Morgul E, Bener A, Atak M, Akyel S, Aktaş S, Bhugra D, Ventriglio A & Jordan, T. R. (2021). COVID-19 pandemic and psychological fatigue in Turkey. *The International Journal of Social Psychiatry* 67(02):128–135
- Morrow EL, Patel NN & Duff, M. C. (2021). Disability and the COVID-19 pandemic: a survey of individuals with traumatic brain injury. *Archives of Physical Medicine and Rehabilitation* 102(06):1075–1083
- Petranovich CL, Smith-Paine J, Wade SL, Yeates KO, Taylor HG, Stancin T & Kurowski, B. G. (2020). From early childhood to adolescence: lessons about traumatic brain injury from the Ohio Head Injury Outcomes Study. *The Journal of Head Trauma Rehabilitation* 35:226–239
- Rashid M, Goetz HR, Mabood N, Damanhoury S, Yager JY, Joyce AS & Newton, A. S. (2014). The

- impact of pediatric traumatic brain injury (TBI) on family functioning: a systematic review. *Journal of Pediatric Rehabilitation Medicine* 7(03):241–254
- Riccardi JS & Ciccia, A. (2021). Cognitive fatigue in pediatric traumatic brain injury: a meta-analysis and scoping review. *The Journal of Head Trauma Rehabilitation* 36(04):226–241
- Salley J, Krusen S, Lockovich M, Wilson B, Eagan-Johnson B & Tyler, J. (2019). Maximizing expertise and collaboration to support students with brain injury: a case study in speech-language pathology. *Perspectives of the ASHA Special Interest Groups* 4 (06):6
- Spina S, Ziviani J & Nixon, J. (2005). Children, brain injury and the resiliency model of family adaptation. *Brain Impairment* 6(01):1
- Styck KM, Malecki CK, Ogg J & Demaray, M. K. (2021). Measuring COVID-19-related stress among 4th through 12th grade students. *School Psychology Review* 50(04):4
- Treble-Barna A, Zang H, Zhang N, Taylor HG, Yeates KO & Wade, S. (2017). Long-term neuropsychological profiles and their role as mediators of adaptive functioning after traumatic brain injury in early childhood. *Journal of Neurotrauma* 34(02): 353–362
- Tso WW. Y, Wong RS, Tung KT. S, Rao N, Fu KW, Yam JC. S, Chua GT, Chen EY. H, Lee TM. C, Chan SK. W, Wong WH. S, Xiong X, Chui CS, Li X, Wong K, Leung C, Tsang SK. M, Chan GC. F, Tam PK. H . . . Lp, P. (2022). Vulnerability and resilience in children during the COVID-19 pandemic. *European Child & Adolescent Psychiatry* 31:161–176
- Ueda R, Okada T, Kita Y, Ozawa Y, Inoue H, Shioda M, Kono Y, Kono C, Nakamura Y, Amemiya K, Ito A, Sugiura N, Matsuoka Y, Kaiga C, Kubota M & Ozawa, H. (2021). The quality of life of children with neurodevelopmental disorders and their parents during the coronavirus disease 19 emergency in Japan. *Scientific Reports* 11(01):3042
- van Markus-Doornbosch F, de Kloet AJ, Berger MA. M, Lambregts SA. M, Wolterbeek R & Vliet Vlieland, T.P. M. (2016). . Factors related to fatigue after paediatric acquired brain injury (ABI). *Brain Injury : [BI]* 30(13-14), 1533–1541
- Varni JW (1998a). *Pediatric Quality of Life Generic Core Scales*. Mapi Research Trust
- Varni JW (1998b). *Pediatric Quality of Life Multidimensional Fatigue Scale*. Mapi Research Trust
- Varni JW, Seid M & Kurtin, P. S. (2001). PedsQL 4.0: Reliability and validity of the Pediatric Quality of Life Inventory version 4.0 generic core scales in healthy and patient populations. *Medical Care* 39 (08):800–812
- Viola A, Balsamo L, Neglia JP, Brouwers P, Ma X & Kadan-Lottick, N. S. (2017). The behavior rating inventory of executive function (BRIEF) to identify pediatric acute lymphoblastic leukemia (ALL) survivors at risk for neurocognitive impairment. *Journal of Pediatric Hematology/Oncology* 39(03):174–178
- Warren MA & Bordoloi, S. D. (2020). When COVID-19 exacerbates inequities: the path forward for generating wellbeing. *International Journal of Well-being* 10(03):3
- Yeates KO, Taylor HG, Woodrome SE, Wade SL, Stancin T & Drotar, D. (2002). Race as a moderator of parent and family outcomes following pediatric traumatic brain injury. *Journal of Pediatric Psychology* 27(04):393–403
- Zengin M, Yayan EH, Vicnelioğlu E (2021). The effects of the COVID-19 pandemic on children's lifestyles and anxiety levels. *Journal of Child and Adolescent Psychiatric Nursing* 34(03):236–242