



# Child and family factors associated with child mental health and well-being during COVID-19

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## Abstract

Understanding the implications of the COVID-19 pandemic on the current generation of youth is critical for post-pandemic recovery planning. This study aimed to identify the most salient child (i.e., connectedness to caregivers, screen time, sleep, physical activity, peer relationships, and recreational activities) and family (i.e., COVID-19 financial impact, maternal depression and anxiety) factors associated with children's mental health and well-being during the COVID-19 pandemic, after controlling for pre-pandemic mental health. This study included 846 mother–child dyads (child age 9–11) from the All Our Families cohort. Mothers reported on the child's pre-pandemic mental health at age 8 (2017–2019) and during COVID-19 (May–July 2020), the family's financial impact due to COVID-19, and maternal depression and anxiety. During COVID-19 (July–August 2020), children reported on their screen time, sleep, physical activity, peer and family relationships, and recreational activities, as well as their happiness, anxiety and depression. After controlling for pre-pandemic anxiety, connectedness to caregivers ( $B = 0.16$ ; 95% CI  $-0.22$  to  $-0.09$ ), child sleep ( $B = 0.11$ ; 95% CI  $-0.19$  to  $-0.04$ ), and child screen time ( $B = 0.11$ ; 95% CI  $0.04$ – $0.17$ ) predicted child COVID-19 anxiety symptoms. After controlling for pre-pandemic depression, connectedness to caregivers ( $B = 0.26$ ; 95% CI  $-0.32$  to  $-0.21$ ) and screen time ( $B = 0.09$ ; 95% CI  $0.02$ – $0.16$ ) predicted child COVID-19 depressive symptoms. After controlling for covariates, connectedness to caregivers ( $B = 0.36$ ; 95% CI  $0.28$ – $0.39$ ) predicted child COVID-19 happiness. Fostering parent–child connections and promoting healthy device and sleep habits are critical modifiable factors that warrant attention in post-pandemic mental health recovery planning.

**Keywords** COVID-19 · Child · Mental health · Screen time · Sleep · Parent–child connections

## Introduction

Children have experienced significant life disruptions as a result of the COVID-19 pandemic, including school closures, social distancing, missed milestones, and family stress (e.g., income loss and parent mental illness) [1, 2].

The potential for the COVID-19 pandemic to have significant consequences for child mental health and well-being has garnered considerable attention from parents, the media, health practitioners, and policy makers, leading many to ask “are the kids alright?” While empirical evidence is beginning to suggest a significant increase in children's mental health symptoms [3–5], few studies have clearly identified the socio-environmental factors associated with children's

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mental health struggles during the COVID-19 pandemic. Thus, research identifying the most salient child and/or family COVID-19-specific predictors of child mental health and well-being, while accounting for pre-pandemic mental health and well-being, has been identified as an urgent research priority [6, 7] to adequately inform intervention and recovery efforts.

Child mental health during COVID-19 is likely multiply determined [8] and contingent on both parent and family factors, as well as more direct individual or child factors. Past research suggests that environmental and economic crises impact family functioning and ultimately influence children's mental health [9, 10]. Moreover, child mental health is often dependent on the functioning and well-being of the family unit [8, 11]. For example, maternal mental health is often a robust predictor of child mental health and well-being [12, 13]. During COVID-19, a near doubling of maternal anxiety and depression has been observed [14], along with documented disruptions in family relationships and financial strain due to COVID-19 [15–17]. Each of these factors could play a unique role in children's mental health and well-being during COVID-19.

Decades of observational and experimental research has shown that when children feel connected to their caregivers, their developmental health is optimized [18–23]. However, as children move into the later stages of middle childhood, peer relationships take on more primacy. One of the most prominent COVID-19 changes for school-aged children has likely been separation from peers due to school closures and social-distancing orders. The COVID-19 pandemic has also impacted children's daily routines and functioning [24–27]. Indeed, changes in children's sleep routines, levels of screen time, physical activity, and engagement in recreational activities during COVID-19 have been observed [28, 29]. Importantly, research has shown that when children experience changes and disruptions in these individual factors, it can precipitate mental health difficulties [2].

Methodologically rigorous research is needed to highlight targets for intervention for children to recover and thrive in a post-pandemic future. The current multi-informant study of mothers and children aged 9–11 aimed to identify the strongest predictors of child COVID-19 anxiety, depression, and happiness, while leveraging pre-pandemic data to control for pre-existing mental health and well-being. It is critical to study mental health and well-being in middle childhood as this developmental period is marked by a significant increase in mental health disorder symptoms [30], and once increases in mental health are observed, children can be at risk for more sustained mental health struggles across adolescence and adulthood [31, 32]. We hypothesized that child pre-pandemic mental health, along with maternal mental health and child connectedness to caregivers during COVID-19, would be the

strongest predictors of child mental health and well-being during COVID-19. Given the considerable disruptions and shifts in children's daily routines during COVID-19, we also hypothesized that higher screen time and lower sleep, physical activity and connectedness to peers would predict poorer mental health during the COVID-19 pandemic, over and above other predictors. Overall, this study will identify prominent threats to children's mental health during the COVID-19 pandemic and help to inform prevention and intervention efforts.

## Materials and methods

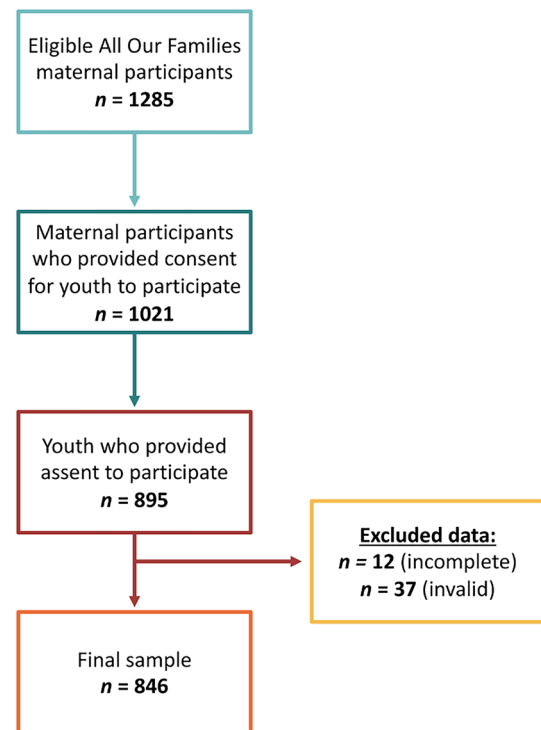
### Study design and population

Mothers and children ( $n = 846$ ) were drawn from the All Our Families (AOF) cohort in Calgary, Canada (Table 1) [33, 34]. Women were recruited in pregnancy (August 2008–December 2010) and followed for 9–11 years postpartum, including a COVID-19 survey, with over a 70% retention rate on average. Inclusion criteria were: (1)  $\geq 18$  years, (2) fluent in English, (3) gestational age  $< 24$  weeks, and (4) receiving community-based prenatal care. When children were 8 years old (2017–2019), mothers completed a standardized questionnaire on their child's mental health. During COVID-19 (May–July 2020;  $n = 1285$ ), mothers completed a COVID-19 survey and were also contacted to invite their children (9–11 years;  $M = 9.85$ ,  $SD = 0.78$ ) to participate in a COVID-19 child survey (July–August 2020). Of these 1285 mothers, 1021 (79.5%) provided consent for their child to participate, and of those, 895 (87.7%) children provided assent to participate. Among children who provided assent, 12 (1.3%) were excluded due to incomplete data and 37 (4.2%) were excluded due to invalid data as they indicated their answers were 'not at all true' (Fig. 1). In Alberta, the first case of COVID-19 was identified on March 5th, 2020 and a state of emergency mandating the closure of all schools and childcare facilities, and the implementation of physical distancing and self-isolation orders, were made on March 15th, 2020. Public schools did not re-open until September 2020. Prior to COVID-19, 97% of the sample regularly attended school outside of the home. At the time of the COVID-19 survey, 10% of families reported having a personal experience with COVID-19 (i.e., personal infection, infection of a child, extended family member or close friend), 58% of all families had some form of financial impact (e.g., at least one parent experienced job loss, loss of main income source, or reduction in employment hours), and over 30% of mothers reported elevated stress, anxiety and depression, as well as concern about their child's behavior

**Table 1** Descriptive characteristics for the final COVID-19 sample ( $n = 846$ )

Characteristic	Value
Child sex, no. (%)	
Male	447 (52.8)
Female	398 (47.1)
Missing	1 (0.1)
Child age, no. (%)	
9 years	334 (39.5)
10 years	308 (36.4)
11 years	203 (24.0)
Missing	1 (0.1)
Maternal race/ethnicity, no. (%)	
Asian	104 (12.2)
Black	4 (0.5)
First Nations, Inuit, Metis	2 (0.2)
Latin	11 (1.3)
Other/mixed	22 (2.6)
White	701 (82.9)
Missing	2 (0.3)
Household income before COVID-19 <sup>a</sup> , no. (%)	
$\geq \$80,000$	679 (80.3)
$\leq \$79,999$	139 (16.4)
Missing	28 (3.3)
Impact of COVID-19 on resources <sup>b</sup> , no. (%)	
No	484 (57.2)
Yes	362 (42.8)
Maternal depression <sup>c</sup> , mean (SD)	7.78 (5.6)
Maternal anxiety <sup>d</sup> , mean (SD)	11.63 (4.04)
Connection to caregivers <sup>e</sup> , mean (SD)	10.70 (1.54)
Relationship with school peers, no. (%)	
Better	58 (6.9)
The same	127 (15.0)
Worse	646 (76.4)
Missing	15 (1.7)
Sleep duration, h/night, mean (SD)	9.23 (0.89)
Physical activity, days/week, mean (SD)	5.25 (1.95)
Screen time duration, h/week, mean (SD)	23.65 (11.95)
Recreational activities, mean (SD)	30.13 (7.97)
Mental health at 8-year survey <sup>f</sup> , mean (SD)	
Anxiety symptoms	49.48 (10.43)
Depressive symptoms	50.08 (9.78)
Adaptive skills	51.05 (9.10)
Mental health at COVID-19 survey, mean (SD)	
Anxiety symptoms <sup>g</sup>	48.84 (10.22)
Depressive symptoms <sup>g</sup>	48.61 (8.07)
Happiness score <sup>e</sup>	20.73 (4.19)

<sup>a</sup>Measured in Canadian Dollars; <sup>b</sup>Defined as difficulty meeting financial and/or essential needs; <sup>c</sup>Center for Epidemiological Studies of Depression Short Form (CES-D-10); <sup>d</sup>Spielberger State Anxiety Inventory—Short Form (SSAI-SF); <sup>e</sup>Middle Years Development Instrument (MDI); <sup>f</sup>Behavior Assessment System for Children, second edition (BASC-2); <sup>g</sup>Behavior Assessment System for Children (BASC-3)

**Fig. 1**

and mood [35, 36]. All procedures were approved by the institutional ethics board.

### Pre-pandemic factors

Prior levels of child mental health are important confounders to consider when examining the relation between COVID-19 predictors and child mental health outcomes. To control for these confounders, we included maternal report of children's pre-pandemic anxiety, depressive symptoms or adaptive skills (e.g., adaptability, communication, and social skills) at 8 years of age (2017–2019), using the Behavior Assessment System for Children (BASC-2) [37]. Standardized T-scores were used with higher scores indicating greater symptoms or adaptive behavior at age 8. We also controlled for child sex (male, female) and age (9–11 years), since these factors are significantly associated with a number of the predictors [38–41] as well as the child mental health outcomes [42–47].

### COVID-19 predictors of child mental health and well-being

*Maternal-Report of Family COVID-19 Factors (May–July 2020)* Using the 10-item Center for Epidemiological Studies of Depression Short Form (CES-D-10) mothers self-reported symptoms of depression in the past week. The CES-D-10 has strong psychometric properties and is frequently used

in primary care settings to screen for depressive symptoms [48, 49]. Internal consistency in the current sample was high ( $\alpha=0.87$ ). Using the 6-item Spielberger State Anxiety Inventory Short Form (SSAI-SF), mothers self-reported on current symptoms of anxiety [50]. The SSAI-SF has good internal consistency and has been validated for use with mothers [51, 52]. Internal consistency was high ( $\alpha=0.86$ ). Mothers also reported whether COVID-19 had impacted their ability to meet family needs [1, minor, moderate or major difficulty meeting financial and/or essential needs (i.e., rent or mortgage payments, utilities and groceries); 0, no impact or too soon to tell].

*Child-Report of Individual COVID-19 Factors (July–August 2020)* During COVID-19, children reported on the parent–child relationship using the Connections with Adults at Home subscale of the Middle Years Development Instrument (MDI) [53]. Children indicated on three items (e.g., “In my home there is a parent or another adult who listens to me when I have something to say.”) how much they agree with each statement (1, not at all true; 4, very much true) and higher scores indicated greater connection to caregivers. The Connections with Adults at Home subscale of the MDI showed adequate reliability in the current sample ( $\alpha=0.70$ ).

During COVID-19, children also reported on the duration of time they spent using electronic devices on a typical weekday and weekend day outside of schoolwork (0, none; 7, 7 or more hours), and a weighted weekly average was derived with higher scores indicating greater screen time duration per week. Children self-reported how many of the last 7 days they participated in physical activity that made their heart rate go up for at least 60 minutes (0, 0 days; 7, 7 days), and how long they slept on a typical night (1, less than 7 hours; 8, 10 hours or more). Higher scores indicated longer durations of physical activity and sleep. Children reported how often they engaged in 11 different recreational activities (e.g., crafts, hobbies, music, and exploring nature; 0, never; 5 many times a day) and a summed score was calculated across all items. Higher scores represent greater engagement in recreational activities. Lastly, children reported how connected they currently (i.e., during COVID-19) felt to their school peers (1, less; 3, more).

### Outcome measures: child mental health and well-being during COVID-19

As children emerge into the late stages of middle childhood, they are considered the best informants of their own behavior [54]. Thus, children self-reported on symptoms of depression and anxiety during COVID-19 (July–August 2020), using the Behavior Assessment System for Children (BASC-3) [55]. Standardized T-scores were used, with higher scores indicating greater symptoms. The BASC-3 is a widely used tool to

assess mental health difficulties and has strong psychometric properties [55]. Internal consistency was high ( $\alpha=0.83$  and  $\alpha=0.88$ , respectively).

Using the Middle Years Development Instrument (MDI) [53], children also self-reported their levels of happiness, or subjective well-being. Children indicated on five items how much they agree with each statement (1, disagree a lot; 5, agree a lot) and higher scores indicated greater levels of happiness. The MDI has strong psychometric properties [53] and showed high reliability in the current sample ( $\alpha=0.86$ ).

### Statistical analysis

Multivariable linear regression analysis was used to predict each outcome independently—anxiety, depression, and happiness. Effect modification was tested in each of the regression models based on child sex (male, female), child age (9, 10, 11), and previous at-risk mental health status (T-score  $\geq 60$  vs. T-score  $< 60$ ) at 8 years of age (BASC-2), using Chi-square difference tests with the Satorra–Bentler scaling correction to adjust for nested models [56]. As noted above, the BASC-2 subscales for anxiety and depression were used as covariates for COVID-19 mental health. However, for the happiness model, child happiness was not measured pre-COVID-19, thus the BASC-2 adaptive skills composite (e.g., social skills, adaptability, leadership, and communication skills) at age 8 was used as a pre-pandemic proxy, as components of this composite have been shown to correlate with happiness [57]. All analyses were conducted in Mplus 8.1 [58], using Robust Maximum Likelihood [59]. Standardized estimates ( $B$ ) with 95% confidence intervals (CIs) are reported.

### Missing data

When compared to all families who completed the maternal COVID-19 survey ( $n=1285$ ), mothers of children who completed the COVID-19 child survey ( $n=846$ ) had lower depressive symptoms ( $t=-2.34$ ,  $p=0.020$ ) and were more likely to report having a partner during COVID-19 ( $t=-2.86$ ,  $p=0.004$ ). The two groups did not differ on measures of maternal anxiety or impact of COVID-19 on family resources, and children who participated did not differ based on child age, sex, or mental health pre-COVID-19 (anxiety, depression).

## Results

### Descriptive statistics

Descriptive statistics and correlations are presented in Tables 1 and 2, respectively. During COVID-19, 13.8% ( $n=122$ ) of children reported anxiety symptoms, and 8.2%

( $n = 72$ ) reported depressive symptoms, that were in the at-risk or clinical score range ( $t$ -score  $\geq 60$ ). Based on the standardized scoring for the MDI, 44.2% ( $n = 374$ ) of the children reported high levels of happiness. As displayed in Table 2, anxiety and depression subscales of the BASC-2 at 8 years (maternal report) and the BASC-3 at COVID-19 (child self-report;  $r = 0.31$ ,  $p < 0.001$ , respectively) were moderately correlated. Adaptive skills at age 8 (maternal report) and happiness at COVID-19 (child self-report) were also significantly correlated ( $r = 0.24$ ,  $p < 0.001$ ).

## Model testing

**Child anxiety symptoms.** After controlling for child sex, age, and anxiety symptoms pre-COVID-19, connectedness to caregivers ( $B = 0.16$ ; 95% CI,  $-0.22$  to  $-0.09$ ), child sleep ( $B = 0.11$ ; 95% CI  $-0.19$  to  $-0.04$ ), and child screen time duration ( $B = 0.11$ ; 95% CI  $0.04$ – $0.17$ ) were significant unique predictors of child COVID-19 anxiety symptoms (Table 3). Overall, the predictors accounted for 17% of the variance in the model.

**Child depressive symptoms** After controlling for child sex, age, and depressive symptoms pre-COVID-19, connectedness to caregivers ( $B = 0.26$ ; 95% CI  $-0.32$  to  $-0.21$ ) and child screen time duration ( $B = 0.09$ ; 95% CI  $0.02$ – $0.16$ ) were significant unique predictors of child COVID-19 depressive symptoms (Table 3). Overall, the predictors accounted for 19% of the variance in the model.

**Child happiness** After controlling for child sex, age, and adaptive skills pre-COVID-19, connectedness to caregivers ( $B = 0.36$ ; 95% CI  $0.28$ – $0.39$ ) was a significant unique predictor of child happiness during COVID-19 (Table 3). Overall, the predictors accounted for 22% of the variance in the model.

When examining the anxiety, depression, and happiness regression models stratified by sex (male, female), age (9, 10, 11), and previous mental health status (BASC-2 T-score  $\geq 60$  at 8 years of age vs. T-score  $< 60$ ), independently, no significant differences were found for the overall models (Table 4).

## Discussion

Child and family stressors related to COVID-19 have been pervasive and the world has become an even more challenging place for children to thrive. Thriving is all the more difficult as children transition to early adolescence, a period marked by significant biological and contextual change [60], coinciding with an increase in mental health difficulties [30]. Thus, there is urgency in identifying threats to children's mental health, to build health capital and to inform universal and targeted prevention and intervention strategies

based on the needs of children on account of the unprecedented disruptions brought on by COVID-19. To answer these questions, and inform these efforts, cohort studies that can account for prior mental health status are needed. Using multi-informant data from a longitudinal cohort, this study identifies the most salient child and family factors predicting child mental health during COVID-19.

One of the most prominent predictors of child mental health difficulties is prior mental health [61, 62]. The large effects sizes [63] found herein between pre-pandemic and COVID-19 child mental health suggests that children who struggled with mental health symptoms prior to COVID-19, are also struggling during COVID-19. This reiterates the need for high-quality and accessible mental health resources for children, and in the context of COVID-19, increased points of access potentially through e-mental health, virtual appointments, and evidence informed online interventions. Follow-up research is needed to understand the patterns of mental health that change or are maintained as the COVID-19 pandemic unfolds. Identifying the mechanism that explain why some children will experience long-term mental health difficulties after the pandemic, whereas some children will not, is an urgent research priority.

After accounting for children's pre-existing mental health and well-being, several salient and unique COVID-19-specific predictors emerged. Child-reported sense of connectedness to caregivers was a moderate to strong predictor of their COVID-19 depression, anxiety, and happiness. This finding is consistent with a robust body of literature that supports the importance of parental warmth and connection for children's developmental health outcomes [18–21, 64]. Moreover, connection to caregivers may be playing a particularly salient role when access to other traditional supports (e.g., peers, teachers and coaches) is limited or unavailable due to COVID-19 restrictions. When considering prevention and intervention strategies to recover from COVID-19, bolstering connectedness within the family unit may have downstream impact on children's mental health [8].

Over and above the effects of pre-COVID-19 mental health and family connections, child-reported screen time and sleep duration predicted COVID-19 child mental health. These small effects suggest that children who engaged in higher durations of screen time during COVID-19 also reported higher levels of depressive and anxiety symptoms. Children who reported lower durations of sleep reported higher levels of anxiety symptoms. These findings are consistent with past research showing that healthy daily habits for school-aged children can reduce the risk for mental health difficulties and increase well-being [32, 65–68]. Clinically, especially in times of great disruption, it is important to encourage families to establish and maintain healthy structured routines including establishing adequate sleep schedules and hygiene, and to involve children in creating

**Table 2** Correlations among COVID-19 predictors, pre-pandemic mental health, and COVID-19 child mental health and well-being

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Impact of CVD-19	1														
2. Maternal anxiety	0.23 <sup>b</sup>	1													
3. Maternal depression	0.22 <sup>b</sup>	0.71 <sup>b</sup>	1												
4. Connection to caregivers	-0.03	-0.02	-0.06	1											
5. Peer relationships	0.00	-0.02	0.02	-0.06	1										
6. Sleep	-0.14 <sup>b</sup>	-0.08 <sup>a</sup>	-0.09 <sup>b</sup>	0.15 <sup>b</sup>	0.03	1									
7. Physical activity	0.00	-0.04	-0.11 <sup>b</sup>	0.06	0.11 <sup>b</sup>	0.14 <sup>b</sup>	1								
8. Screen time	0.11 <sup>b</sup>	0.05	0.09 <sup>b</sup>	-0.13 <sup>b</sup>	0.07 <sup>a</sup>	-0.18 <sup>b</sup>	-0.25	1							
9. Activities	0.01	-0.08 <sup>a</sup>	-0.13 <sup>b</sup>	0.20 <sup>b</sup>	0.04	0.13 <sup>b</sup>	0.33 <sup>b</sup>	-0.39 <sup>b</sup>	1						
10. 8-year depression	0.08 <sup>a</sup>	0.21 <sup>b</sup>	0.24 <sup>b</sup>	-0.14 <sup>b</sup>	-0.05	-0.10 <sup>b</sup>	-0.11 <sup>b</sup>	0.04	-0.10 <sup>b</sup>	1					
11. 8-year anxiety	0.06	0.19 <sup>b</sup>	0.26 <sup>b</sup>	-0.00	-0.01	-0.06	-0.08 <sup>a</sup>	0.05	-0.03	0.59 <sup>b</sup>	1				
12. 8-year adaptive skills	-0.07	-0.23 <sup>b</sup>	-0.26 <sup>b</sup>	0.19 <sup>b</sup>	0.05	0.16 <sup>b</sup>	0.18 <sup>a</sup>	-0.11 <sup>b</sup>	0.25 <sup>b</sup>	-0.46 <sup>b</sup>	-0.24 <sup>b</sup>	1			
13. CVD-19 depression	0.06	0.10 <sup>b</sup>	0.13 <sup>b</sup>	-0.40 <sup>b</sup>	0.02	-0.13 <sup>b</sup>	-0.06	0.14 <sup>b</sup>	-0.11 <sup>b</sup>	0.31 <sup>b</sup>	0.19 <sup>b</sup>	-0.19 <sup>b</sup>	1		
14. CVD-19 anxiety	0.04	0.13 <sup>b</sup>	0.16 <sup>b</sup>	-0.21 <sup>b</sup>	0.01	-0.17 <sup>b</sup>	-0.11 <sup>b</sup>	0.16 <sup>b</sup>	-0.08 <sup>a</sup>	0.29 <sup>b</sup>	0.31 <sup>b</sup>	-0.14 <sup>b</sup>	0.68 <sup>b</sup>	1	
15. CVD-19 happiness	-0.06	-0.12 <sup>b</sup>	-0.14 <sup>b</sup>	0.46 <sup>b</sup>	-0.02	0.15 <sup>b</sup>	0.15 <sup>b</sup>	-0.15 <sup>b</sup>	0.20 <sup>b</sup>	-0.23 <sup>b</sup>	-0.12 <sup>b</sup>	0.24 <sup>b</sup>	-0.61 <sup>b</sup>	-0.44 <sup>b</sup>	1

CVD-19 COVID-19, <sup>a</sup> =  $p < 0.01$ ; <sup>b</sup> =  $p < 0.05$

Maternal COVID-19 predictors (1–3) were measured from May to July 2020, child COVID-19 predictors (4–9) and mental health and well-being during COVID-19 (13–15) were measured from July to August 2020, and pre-pandemic mental health (10–12) was measured between 2017 and 2019



**Table 3** Multivariable linear regressions predicting child self-report mental health and well-being during COVID-19

Predictors	Model		
	Anxiety <i>t</i> -score Estimate ( <i>B</i> ), 95% (CI)	Depression <i>t</i> -score Estimate ( <i>B</i> ), 95% (CI)	Happiness score Estimate ( <i>B</i> ), 95% (CI)
Pre-pandemic factors			
Female	<b>0.07, 0.01 to 0.13*</b>	0.01, – 0.05 to 0.07	– 0.05, – 0.11 to 0.01
Age	– 0.02, – 0.08 to 0.04	0.03, – 0.03 to 0.09	<b>– 0.13, – 0.19 to – 0.07*</b>
Age 8 anxiety symptoms	<b>0.28, 0.22 to 0.35*</b>	–	–
Age 8 depressive symptoms	–	<b>0.26, 0.19 to 0.32*</b>	–
Age 8 adaptive skills	–	–	<b>0.14, 0.07 to 0.21*</b>
Family COVID-19 factors (May–July 2020)			
Impact on resources	– 0.02, – 0.09 to 0.04	0.00, – 0.01 to 0.06	– 0.02, – 0.08 to 0.04
Maternal depressive symptoms	0.04, – 0.05 to 0.12	0.05, – 0.03 to 0.13	– 0.04, – 0.12 to 0.04
Maternal anxiety symptoms	0.04, – 0.05 to 0.12	– 0.01, – 0.09 to 0.08	– 0.04, – 0.12 to 0.05
Child COVID-19 factors (July–August 2020)			
Connectedness to caregivers	<b>– 0.16, – 0.22 to – 0.09*</b>	<b>– 0.26, – 0.32 to – 0.21*</b>	<b>0.36, 0.28 to 0.39*</b>
Connection with school peers	0.01, – 0.06 to 0.08	0.02, – 0.05 to 0.09	– 0.03, – 0.10 to 0.04
Sleep	<b>– 0.11, – 0.19 to – 0.04*</b>	– 0.05, – 0.13 to 0.03	0.04, – 0.03 to 0.11
Physical activity	– 0.04, – 0.10 to 0.03	0.02, – 0.04 to 0.09	0.06, – 0.01 to 0.12
Screen time	<b>0.11, 0.04 to 0.17*</b>	<b>0.09, 0.02 to 0.16*</b>	– 0.04, – 0.11 to 0.03
Recreational activities	0.02, – 0.05 to 0.09	0.01, – 0.07 to 0.08	0.05, – 0.02 to 0.12
R <sup>2</sup>	<b>0.17, 0.13 to 0.22*</b>	<b>0.19, 0.14 to 0.24*</b>	<b>0.22, 0.18 to 0.27*</b>

\*Estimates in which 95% CIs do not include 0

**Table 4** Model stratification analyses

Stratified by	Difference test <sup>a</sup>
Anxiety model	
Sex	$\chi^2(11) = 9.93, p = 0.536$
Age	$\chi^2(22) = 24.23, p = 0.335$
Age 8 anxiety	$\chi^2(11) = 8.61, p = 0.658$
Depression model	
Sex	$\chi^2(11) = 6.45, p = 0.842$
Age	$\chi^2(22) = 25.79, p = 0.261$
Age 8 depression	$\chi^2(11) = 12.19, p = 0.349$
Happiness model	
Sex	$\chi^2(11) = 8.99, p = 0.623$
Age	$\chi^2(22) = 25.60, p = 0.269$
Age 8 adaptive skills	$\chi^2(11) = 7.23, p = 0.780$

<sup>a</sup>Chi-square difference test using the Satorra–Bentler scaling correction

family media plans [69, 70] that foster healthy recreational device habit use (e.g., limits on duration).

Although pre-pandemic associations between maternal mental health and child mental health are well established [12, 13], we did not find that maternal anxiety or depression predicted child mental health and well-being during COVID-19. In addition, somewhat surprisingly given the critical role of peers in middle childhood development,

connectedness to peers did not emerge as a significant predictor of mental health and well-being during COVID-19. Due to strict social-distancing orders, peer interactions were reduced and less proximal during this survey period. Thus, it appears that the more salient predictors of child mental health and well-being during COVID-19 were those more proximal, accessible, or directly experienced by the child (e.g., connectedness to caregivers, screen time, and sleep) versus ones that were more external to them (e.g., family income, maternal mental health, and peer interactions).

When the regression models were stratified by child age, sex, or past psychopathology (i.e., scores above the clinical cutoffs), no significant differences were found. For this sample, the child and family COVID-19 predictors observed in this study seem to be impacting youth mental health across age, sex, and prior mental illness, comparably.

## Limitations

Using a large longitudinal cohort with both maternal and child self-report, this study has a number of strengths. However, the following limitations are noted. First, the women recruited into the All Our Families cohort are generally representative of those living in an urban setting with access to universal health care, and consequently, risk estimates for populations more vulnerable to poor outcomes may be underestimated. Second, only a portion of the cohort

participated in the COVID-19 survey likely resulting in some selection bias. However, a recent study using the All Our Families cohort and applying longitudinal non-response weights showed that complete case analysis and a weighted analyses produced similar results [14]. Thus, the direction and pattern of the current results are hypothesized to be similar for the broader sample. Third, although controlling for prior mental health improves the design of this study, and maternal and child reports were collected at different time points during COVID-19, several child-reported predictors and outcomes were measured cross-sectionally. Further research is needed to better assess how COVID-19 predictors and mental health outcomes are related over the course of the COVID-19 pandemic, and how this impacts children's long-term outcomes. Lastly, the COVID-19 pandemic is not a homogeneous event and youth have been differentially impacted based on a variety of COVID-19 factors (e.g., school closure, parent availability, public health measures, and exposure to COVID-19)[71, 72]. Although this study was designed to better understand some of the influential factors associated with child mental health during the COVID-19 pandemic, it does not encapsulate all factors present during the pandemic (e.g., different public health mandates by country, different schooling modalities, and varying levels of exposure to COVID-19).

## Conclusions

In addition to previous mental health difficulties, connections with caregivers and healthy device and sleep habits are important predictors of child mental health during COVID-19. Fostering parent–child connections and promoting healthy device and sleep habits are critical modifiable factors that warrant attention in pandemic and post-pandemic mental health recovery planning. These findings are relevant for pediatric practice and the promotion of routines (e.g., sleep, physical activity, and screen time), resources (e.g., access to mental health education and treatment), and relationships (e.g., parent–child) for youth and their families to enhance children's emotional health and well-being. These strategies would likely be beneficial for many children, but further research is needed to determine if vulnerable groups not specifically targeted in this study require other forms of supportive or preventative measures. The strategies used to care for children and their families during this time of global crisis could mitigate the potential cost of COVID-19 on children's lifelong trajectories [73]. Additional longitudinal research is needed to determine if the predictors found herein remain relevant throughout COVID-19, and in a post-pandemic future.

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**Author contributions** BM and SM secured funding for data collection, conceptualized and designed the study, conducted data analyses, drafted the manuscript, and reviewed and revised the manuscript. NR secured funding for data collection and critically reviewed the manuscript for important intellectual content. SM and ST conceptualized the cohort study, designed the data collection instruments and study methodology, secured funding for data collection, and critically reviewed the manuscript for important intellectual content. All the authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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**Availability of data and materials** The All Our Families meta-data are available through a third-party data curator, SAGE/Policywise (<https://sagemetadata.policywise.com/nada/index.php/catalog/1>). Investigators can submit a proposal that has been approved by an independent ethics and scientific review committee to obtain de-identified individual participant data. Data requestors will need to sign confidentiality and access agreements.

**Code availability** Not applicable.

## Declarations

**Conflict of interest** The authors have no conflicts of interest to disclose.

**Ethics approval** The current study was approved by the University of Calgary Institutional Review Board. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

**Consent to participate** Informed consent was obtained from all mothers included in the study. In addition, all children provided assent to participate.

**Consent for publication** Not applicable.

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