

POPULATION STUDY ARTICLE



Preschooler screen time and temperamental anger/frustration during the COVID-19 pandemic

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BACKGROUND: In the context of increased media use and family distress during the pandemic, we examine whether preschooler screen time at age 3.5 contributes to later expressions of anger/frustration at 4.5, while also considering the inverse association. **METHODS:** Data are from a cohort of 315 Canadian preschool-aged children during the COVID-19 pandemic. Parent-reported measures included child h/day of screen time and child temperamental anger/frustration, both measured at 3.5 and 4.5 years of age. Indicators of family distress include use of childcare and child sleep, family income, parenting stress, and parent education, marital and employment status. We also consider child sex as a control variable. **RESULTS:** A crossed-lagged panel model revealed continuity in screen time between the ages of 3.5 and 4.5 ($\beta = 0.68$) and temperamental anger/frustration from 3.5 to 4.5 ($\beta = 0.60$). Child screen time at age 3.5 predicted increased proneness to anger/frustration at age 4.5 ($\beta = 0.14$). Anger/frustration at age 3.5 did not predict screen time at age 4.5. **CONCLUSION:** Our results suggest that preschooler screen time during the pandemic may have undermined the ability to regulate negative emotions, a key component of social and academic competence. Supporting parents in implementing healthy media habits post pandemic may benefit young children's development.

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IMPACT:

- Key message: this study observes prospective bidirectional associations between preschoolers screen time and temperamental displays of anger or frustration during the COVID-19 pandemic.
- What does it add: we provide evidence that preschool screen time at age 3.5 prospectively contributes to the tendency to react in anger/frustration at age 4.5. In contrast, greater proneness to anger/frustration did not predict later exposure to screen time.
- What is the impact: health practitioners should enquire about media use habits during well-child visits to foster children's healthy development during the preschool years.

PRESCHOOLER SCREEN TIME AND TEMPERAMENTAL ANGER/FRUSTRATION DURING THE COVID-19 PANDEMIC

Children's expressions of anger/frustration tend to decrease over the course of childhood due to maturation and improved communication and emotional regulation skills.¹ Eventually, the effective management of negative emotions contributes to school readiness and the ability to interact competently with peers and teachers.^{2–4} Furthermore, children who experience more difficulty downregulating anger and frustration are at increased risk of developing internalizing and externalizing psychopathology as well as long-term physical health problems.^{5–7}

Some adverse experiences including negative maternal behavior toward the child have been negatively linked to children's ability to regulate anger and frustration.⁸ Yet associations between preschooler screen media intake and proneness to anger/frustration remain unexplored. Heavy media intake by preschoolers has been linked to academic, behavioral, and emotional

difficulties, which may reflect underlying difficulties with emotional regulation.^{9–14} These observed associations are consistent with the hypothesis that child screen time is likely to displace time for activities that build emotional competence such as sensitive interactions with caregivers.

Children who more frequently express anger and frustration may also be at greater risk of being exposed to screens. Research with preschoolers suggests that both internalizing and externalizing behavior in preschoolers can increase risk of screen time exposure.¹⁴ Research with younger infants has also shown that negative affectivity, which encompasses child tendency to anger/frustration, contributes to more problematic media use by toddlers.¹⁵ Furthermore, longitudinal and cross-sectional research studies have also shown that parents are likely to expose fussier, more difficult infants and toddlers to more screen time.^{16,17} As such, it remains important to examine if the association between child exposure to screens and temperamental anger/frustration is bidirectional.

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The COVID-19 pandemic presents a unique window in which to examine the impact of screen media on children's development. Stay at home orders and forced school and daycare closures have had a profound impact on the routines of families with young children. These changes and disruptions occasioned by them, are likely to have contributed to increased family distress and child exposure to screen time.¹⁸ In particular, parents may have used digital media with young children to keep them busy or distracted when they needed to complete other tasks or take a break.¹⁹ Recent data suggest that 64% of preschoolers were exposed to more than 2 h of screen time per day during the pandemic,²⁰ despite recommendations of limiting child screen time to 1 h per day for this age group.²¹ For this reason, it remains important to consider how indicators of family distress in terms of reduced access to personal and financial resources, may have contributed to child screen time intake.

To our knowledge, no research has examined bidirectional associations between preschooler screen time and later proneness to temperamental anger/frustration, an important individual determinant of behavior and reactions to one's environment. As such, the present study aims to investigate how child screen time at age 3.5 contributes to anger frustration at the age of 4.5 and vice versa. Given the context of the pandemic, we also examine how child time spent in childcare and sleep, as well as parenting stress, maternal education, marital and employment status, and family income, contributes to screen time and anger/frustration at age 4.5. We then examine whether a bidirectional association exists between screen media use and anger frustration between the ages of 3.5 and 4.5. We hypothesize a bidirectional association by which screen media use at age 3.5 will predict increased anger/frustration at age 4.5 and higher levels of anger/frustration at age 3.5 will predict more screen time at age 4.5.

METHODS

Study design

Parents completed the Media Assessment Questionnaire (MAQ) to assess child digital media use at both data assessment waves. They also completed an online 24-h recall diary at the first assessment. Both measures were developed to capture digital media use by modern households and have been described elsewhere.²² The MAQ includes questions about child's sex, parenting stress, and parent education, employment, and marital status, and family income. For our study, we integrated questions on child anger/frustration to the survey. Measures are described below. Our analysis plan was not pre-registered. However, the present research hypotheses were formulated for a Nova Scotia Establishment grant submitted and awarded in 2019 (application #2061). The present research was approved by Université Sainte-Anne (#0090.d) and Université de Sherbrooke's IRB (2021–2927). Informed consent to participate was obtained from parents.

Sample

This study draws on participants followed longitudinally over the span of 2 years for a study of preschooler digital media use during the pandemic. Participants were recruited by distributing eye-catching posters and flyers to preschools and pre-kindergarten classes, through sign-up sheets and presentations given at preschool and pre-kindergarten registration nights, a Facebook page, and newspaper and radio advertisements broadcast across Nova Scotia, Canada. An initial assessment took place at the start of the pandemic in 2020 between April and August ($N = 315$, mean age = 3.45) during a provincially declared state of emergency and lockdown. We collected data on child's digital media habits and child's characteristics (e.g., sex, temperament), as well as the family (e.g., parental education, income) context. Mothers were the primary respondent (93.4%). Most respondents reported being married (82.0%), born in Canada (91.0%), and white (90.5%). Our sample contained slightly more boys (54.0%) than girls. A follow-up with this sample was completed in 2021 between April and August ($N = 265$, mean age = 4.5, 85.0% retention rate), providing us with a second wave of child digital media use and temperamental characteristics.

Measures

Child anger/frustration. Temperament was measured using the Children's Behavior Questionnaire – Short Form.^{23,24} The dimension of Anger/Frustration was based on the mean of seven items, ranging from 0 to 7 (i.e., Child gets angry when told s/he has to go to bed). Cronbach's alpha coefficients were 0.79 and 0.80 for Waves 1 and 2, respectively. Higher scores indicate greater intensity and duration of the child's angry/frustrated response to environmental stimuli.

Child screen time. Measures were derived from the MAQ²² where parents reported the average amount of time children spent doing each of the following on weekdays and weekend days separately: (1) watching TV or DVDs; (2) using a computer; (3) playing video games on a console; (4) using an iPad, tablet, LeapPad, iTouch, or similar mobile device (excluding smartphones); or (5) using a smartphone. Response options included: (1) Never; (2) Less than 30 min; (3) 30 min to 1 h; (4) 1–2 h; (5) 2–3 h; (6) 4–5 h; (7) more than 5 h. We then converted these categorical responses into variables reflecting the number of hours spent with each type of media device. Our approach involved using the midpoint for each response range, with the exception of "Never" where a score of 0 was used, and "5 or more hours a day" where a more conservative score of 5 was used. Weighted daily averages of time spent with each type of media device were then created by multiplying weekday estimates by 5 and weekend day estimates by 2 and dividing the total by 7. Last, we calculated an overall daily screen time estimate by summing the weighted daily average across media devices.

Family distress. Child's weekday sleep and time spent in childcare were recorded by parents using a 24-h time-use diary.²⁵ This online measure allowed parents to log the amount of time their child spent in different activities the previous day (including childcare and sleep) in 15-min intervals.

Parents completed the parenting distress subscale of the Parent Stress Index.²⁵ In total, parents completed 12 items (i.e., I find myself giving up more of my life to meet my child's needs than I ever expected). Items were rated on a 5-point Likert scale as: 1 (strongly disagree); 2 (disagree); 3 (not sure); 4 (agree) or 5 (strongly agree) and were then summed to create a total score ranging from 13 to 51, with an adequate internal consistency (Cronbach's alpha = 0.85).

Parents reported their level of education, family income, marital and employment status at the first data collection wave. Education reflects the highest school grade completed by the parent. Responses were categorized as either: (1) high school or college/vocational; (2) undergraduate; or (3) graduate degree. This variable was then dichotomized to reflect low maternal education (high school or college coded as 1 vs undergraduate or graduate degree coded as 0). Household income was categorized as either (1) less than 60,000 CAD; (2) 60,000–99,000 CAD; or (3) 100,000 CAD or higher. Lastly, parents indicated their marital status as either (married, scored as 0) or (unmarried, scored as 1) and indicated their employment status as either (1) employed, (2) unemployed, or (3) on parental leave.

Statistical analysis

We first estimate two multiple regressions to examine how child screen time, anger/frustration, and indicators of family distress at age 3.5 contribute to later child screen time and anger/frustration at 4.5. In both regressions, we also consider the possibility that child sex and parenting stress moderate these associations, as post hoc analyses. Significant predictors of child outcomes at age 4.5 are then retained in our cross-lagged panel model. Finally, we estimate a cross-lagged panel model to estimate bidirectional associations between screen time and anger/frustration between the ages of 3.5 and 4.5 using Mplus.²⁶

RESULTS

Descriptive statistics and bivariate correlations

Descriptive statistics are presented in Table 1 and distributions for categorical variables are presented in Table 2. Parents reported an average of 3.43 (SD = 2.44) and 3.25 (SD = 2.38) h/day of child screen time at the first and second assessments, respectively. There was no significant change in screen time, or anger/frustration between the ages of 3.5 and 4.5. Table 3 shows bivariate correlations between continuous study variables. Parenting stress at 3.5 was associated with more child expression of

anger/frustration at 3.5 ($r = 0.34$, $p < 0.0001$) and 4.5 ($r = 0.31$, $p < 0.0001$). Child sleep was negatively associated with screen time at age 3.5 ($r = -0.18$, $p < 0.005$) and 4.5 ($r = -0.18$, $p < 0.009$), respectively. Child sleep was also negatively associated with anger/frustration at age 3.5.

We also examined bivariate associations between predictors and categorical variables using Kendall's Tau B correlation. Correlations revealed that belonging to the lowest income group

was positively related to child screen time at age 3.5 ($r = 0.20$, $p < 0.0001$) whereas belonging to the highest income group was negatively related to child screen time at age 3.5 ($r = -0.13$, $p < 0.008$). Furthermore, being unemployed or on parental leave was positively ($r = 0.12$, $p < 0.017$) and negatively ($r = -0.11$, $p < 0.027$) related to child screen time at age 4.5. Lastly, being married was associated with less child screen time at 4.5 ($r = -0.14$, $p < 0.007$). Child sex was not related to child screen time or anger/frustration.

Table 1. Descriptive characteristics for continuous study variables.

	Mean (SD) or %	N
Baseline		
Anger/frustration	4.26 (1.10)	315
Screen time (h/day)	3.43 (2.44)	315
Parenting stress	27.14 (7.88)	315
Child sleep (h/day)	12.13 (1.42)	239
Daycare (h/day)	1.22 (2.85)	239
Child age (years)	3.45 (.86)	315
Parent age (years)	34.91 (4.38)	315
Follow-up		
Anger/frustration	4.27 (4.33)	265
Screen time (h/day)	3.25 (2.38)	266

Table 2. Frequencies for categorical study variables.

	%	N
Child sex		
Male	54	315
Parent ethnicity		
Caucasian	90.8	315
Family income		
<\$60,000	15.9	296
\$60,000–\$100,000	29.5	
>\$100,000	54.6	
Maternal education		
High school or college	25.6	315
Marital status		
Non married	17.8	315
Employment status		
Unemployed	17.5	315
Employed	67.9	
Parental leave	14.6	

Table 3. Bivariate correlations between continuous study variables.

	1	2	3	4	5	6	7
Anger/frustration (age 3.5)	–	0.63***	0.23***	0.22***	0.34***	–0.15*	0.08
Anger/frustration (age 4.5)		–	0.27***	0.26***	0.31***	–0.10	0.03
Screen time (age 3.5)			–	0.70***	0.034	–0.18**	0.01
Screen time (age 4.5)				–	0.01	–0.18**	0.08
Parenting stress (age 3.5)					–	–0.10	0.05
Child sleep						–	–0.33***
Childcare							–

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0001$.

Attrition analyses

We compared retained and unretained participants on baseline characteristics at age 3.5. Retained and unretained participants did not differ in screen time, temperamental anger/frustration, child sex, sleep duration, and number of hours spent in childcare. Furthermore, retained and unretained parents did not significantly differ in parenting stress, marital status, and family income. However, parents with a university degree were more likely than those with a high school/vocational degree to remain in our sample at the second wave, $\chi(1)^2 = 4.24$. Finally, Little's test was computed to evaluate if data were missing completely at Random (MCAR). This test was non-significant ($\chi^2 = 42.08$, $DF = 47$, $p = 0.352$; 0.676), therefore indicating that data could be assumed to be MCAR. We therefore used full-information maximum likelihood estimation to handle missing data in our analyses.

Multiple regression analyses

We regressed screen time and anger/frustration on baseline screen time and anger/frustration and child and family characteristics at age 3.5. These results are shown in Table 4. Screen time at age 3.5 contributed to later screen time ($\beta = 0.55$, $p < 0.0001$) and anger/frustration ($\beta = 0.10$, $p < 0.0001$) at age 4.5. Anger/frustration at age 3.5 also contributed to later screen time ($\beta = 0.39$, $p < 0.0001$) and anger/frustration ($\beta = 0.63$, $p < 0.0001$) at 4.5. None of the other predictors significantly contributed to either outcome.

Post hoc analyses

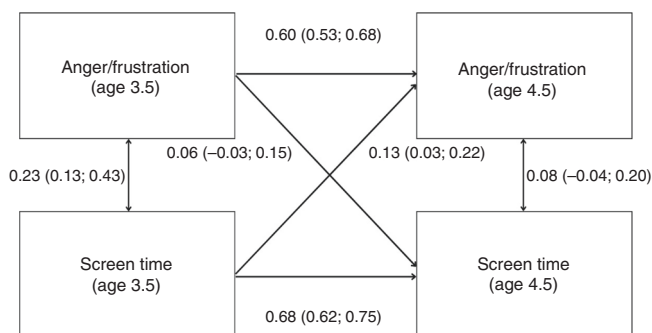
We considered the extent to which the strength and direction of the observed associations may differ based on child sex and parenting stress at 3.5. More specifically, we examined whether the interactions of child sex and anger/frustration at 3.5 and child sex and hours of screen time at 3.5, contributed to outcomes at 4.5. Neither interaction had a significant impact on screen time and anger frustration at age 4.5. We also computed interactions between parenting stress and hours of screen time and parenting stress and child anger/frustration. Neither interaction significantly contributed to screen time or anger frustration at age 4.5.

Cross-lagged panel model

Missing data were handled using Full-information maximum likelihood estimation.²⁷ Child anger/frustration and screen time at age 4.5 were simultaneously regressed on anger/frustration and

Table 4. Contribution of family distress to child screen time and anger/frustration at age 4.5.

	Child outcomes (4.5)			
	Screen time (h/day)		Anger/frustration	
	B (95% CI)	p	B (95% CI)	p
Predictors (age 3.5)				
Screen time (h/day)	0.56 (0.46; 0.66)	<0.0001	0.10 (0.04; 0.15)	<0.0001
Anger/frustration	0.38 (0.15; 0.62)	0.002	0.63 (0.51; 0.75)	<0.0001
Child sex				
Male (ref)	0.09 (−0.39; 0.57)	0.712	−0.22 (−0.47; 0.03)	0.078
Sleep (h/day)	0.01 (−0.18; 0.20)	0.923	0.04 (−0.06; 0.14)	0.430
Parenting stress	−0.03 (−0.06; 0.00)	0.079	0.02 (0.00; 0.03)	0.059
Childcare (h/day)	0.06 (−0.02; 0.15)	0.141	−0.02 (−0.06; 0.03)	0.432
Parent education				
High school/vocational	0.58 (−0.05; 1.20)	0.069	−0.06 (−0.38; 0.27)	0.739
University degree (ref)	–	–	–	–
Marital status				
Married	−0.19 (−0.86; 0.48)	0.576	0.07 (−0.28; 0.42)	0.700
Unmarried (ref)	–	–	–	–
Employment status				
Employed	−0.40 (−1.12; 0.32)	0.274	0.26 (−0.12; 0.63)	0.181
Parental leave	−0.81 (−1.71; 0.09)	0.076	0.27 (−0.20; 0.74)	0.253
Unemployed (ref)	–	–	–	–
Family income				
>\$99,999	−0.19 (−0.97; 0.59)	0.629	0.04 (−0.37; 0.44)	0.849
\$59,999–\$99,999	0.50 (−0.25; 1.25)	0.187	0.18 (−0.21; 0.57)	0.366
<\$59,999 (ref)	–	–	–	–
Rsquare	0.56		0.53	

**Fig. 1** Standardized regression coefficients are presented. 95% confidence intervals are presented in parentheses.

screen time at age 3.5 (see Fig. 1). Our model fit was good (CFI = 1.00; TLI = 1.00; RMSEA \leq 0.05) and accounted for 49% and 41% of the variance in child screen time and anger/frustration at age 4.5, respectively. Child screen time at age 3.5 predicted usage at age 4.5 ($\beta = 0.68$, 95% CI [0.62; 0.75], $p < 0.0001$) and anger/frustration at age 3.5 predicted anger/frustration at age 4.5 ($\beta = 0.60$, 95% CI [0.53; 0.68], $p < 0.0001$). In terms of the cross-lagged associations and providing partial support for our hypotheses, child screen time at age 3.5 significantly predicted increased anger/frustration scores at the age of 4.5 ($\beta = 0.13$, 95% CI [0.03; 0.22], $p = 0.008$), whereas anger/frustration at age 3.5 did not predict screen time at age 4.5 ($\beta = 0.06$, 95% CI [−0.03; 0.15], $p = 0.188$). Anger/frustration was also related to screen time cross-sectionally at age 3.5 ($\beta = 0.23$, 95% CI [0.13; 0.34], $p < 0.0001$).

However, the same cross-sectional association was not significant at age 4.5 ($\beta = 0.08$, 95% CI [−0.04; 0.20], $p = 0.175$).

Clinical significance

Associations between screen time and later anger frustration were in the small range, with each hour of daily screen time contributing to 13% of a standard deviation increase on score of temperamental anger. Nevertheless, this association is likely to be more clinically meaningful for heavy screen media exposure. That is for children using screen media for 4 h or more per day (32.0% of our sample), contribution of daily screen time would result in slightly more than half a standard deviation increase in temperamental anger/frustration.

COMMENT

Our study provided partial support for our hypotheses. Firstly, every hour of screen time at age 3.5 predicted increased expressions of anger and frustration at 4.5. In contrast, higher levels of child anger and frustration at age 3.5 did not predict greater screen time at age 4.5. To our knowledge, our study is the first to show that screen time by preschool-age children may forecast temperamental expression of anger and frustration.

Participants in our sample were on average exposed to levels of screen time that exceed the pediatric recommendations of 1 h/day at age 3.5 (3.46 h/day) and 4.5 (3.25 h/day). These averages may reflect the influence of the pandemic, though other studies have found high levels of non-adherence (3.38 h/day) prior to the pandemic.²⁸ Finally, unlike previous research, with similar measures, children in our sample did not show an average decrease in their expression of anger/frustration between the ages

of 3.5 and 4.5.⁸ Patterns of children's expression of anger/frustration during and post pandemic merits continued investigation.

Young children's emotion regulation skills and ability to modulate the expression of negative emotions are strongly influenced by their temperamental characteristics, including the intensity and frequency at which they experience anger and frustration.²⁹ Although temperament begins to stabilize around the age of 3,³⁰ child experience can modify temperamental traits. Young children, in particular, rely on adult support for emotional regulation.³ Providing children with structured, scaffolded opportunities to exercise emotion regulation with other children can help them improve their emotional competence. Consistent with a displacement hypothesis, excessive screen time may take time away from self-regulation-building pursuits such as imaginary play, storytelling, or social games with other children.³¹ Furthermore, preschooler screen time has been linked to decreased sleep and physical activity, which may further undermine children's ability to effectively modulate their negative emotions.^{32,33}

The present study's findings are also consistent with work on media use for emotion regulation, referring to the use of media by an adult or caretaker to calm an upset child.³⁴ For instance, research has found that parents use media with toddlers as a short-term solution to manage tantrums and emotional outbursts.^{17,35} Overtime, the use of screens by parents as an emotional regulation strategy may undermine children's ability to develop internal means of managing feelings of distress, regardless of their individual disposition toward anger and frustration.^{34,36} As such, future research should address the additional role of timing and parental motives of media usage with young children.

Although previous research has found that more challenging children end up accumulating more screen time,^{17,37} we did not observe a longitudinal association between children's initial expressions of anger and frustration and later screen media usage. Children's screen time intake was relatively high in our sample compared to some estimates from pre-pandemic studies.^{38,39} As such, we may have observed a ceiling-effect for child screen time exposure. Another possibility is that expressions of anger and frustration may lead to increased exposure to screens in children younger than 3³⁴ but not in older preschoolers.

The present study is not without limitations. First, reliance on a single respondent to assess our main predictors and outcomes may have introduced shared measurement bias. Second, our study relies on a relatively homogenous, low-risk convenience sample. We may have observed a significant association between child anger/frustration and screen time in families facing higher levels of adversity. Consequences of screen time are likely to be even more pronounced in more vulnerable populations.^{40,41} In addition it was not possible to examine the extent to which the experience of social isolation and decreased opportunities for peer interactions during the pandemic might have contributed to child outcomes. Finally, we did not account for all features of children's media use. For instance, the quality of the contents to which children were exposed and different types of usages of media (i.e., videochat vs streaming of programs) may moderate the observed associations. Furthermore, contextual features of children's media use including the timing of usage, parental reasoning for using media, and the extent to which parents interacted with children during screen-based activities, may also modify risks for some children. We will examine these possibilities in future research.

Parents should be cautioned that the high levels of digital media intake may have a significant impact not only on children's health, but also on their ability to effectively manage their emotional reactions. Research suggests that parental monitoring behaviors including setting limits on screen time duration and choosing child-directed educational content, and actively

discussing media with children can have a protective long-term effect on children.⁴² Similarly, joint media engagement and teaching children how to effectively disengage from media are also likely to help families build healthy media routines.⁴³ Per the American Academy Pediatrics (AAP) guidelines, the introduction of family media use plans may be beneficial to support families' decision making about parent and child media diets.⁴⁴ Considering that media use has increased during the pandemic, it may be especially important and timely to provide parents with effective tools for regulating their children's digital media use.

Clinically, our results reinforce the importance of including questions about children's digital media use habits during well-child visits and encouraging parents to adopt a family media use plan. Using AAP guidelines, practitioners can review when media is being used, the content of media, and the extent to which it is being used in contexts that benefit children's development. Practitioners can also advocate for the establishment of healthy media diets in early childhood, since attempts to change child media use trajectories that take place in the preschool years are more likely to be effective than those undertaken with older children.⁴⁵

In conclusion, our results suggest that preschooler screen media intake can undermine their ability to successfully regulate negative emotions, a crucial determinant of children's personal success and lifelong mental and physical health. These results further add to the literature by suggesting that the quality of children's experiences and learning opportunities are important for shaping children's temperamental expressions of anger/frustration. As such, we strongly recommend developing healthy media habits with children starting from the preschool years.

DATA AVAILABILITY

The datasets generated during and/or analyzed during the current study are not publicly available due to the participant consent form but are available from the corresponding author upon reasonable request.

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AUTHOR CONTRIBUTIONS

C.F. conceptualized the study, planned the analyses, and drafted the initial manuscript. G.G.-C. conducted the analyses. C.F., M.-A.B., E.H., R.B., M.C. and G.G.-C. critically reviewed the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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COMPETING INTERESTS

The authors declare no competing interests.

CONSENT TO PARTICIPATE

Consent was obtained from all participants for this study.

ADDITIONAL INFORMATION

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