European Society for Paediatric Research
Society for Pediatric Research
www.nature.com/pr

CLINICAL RESEARCH ARTICLE

Check for updates

Pre-pandemic support for shared reading buffers adverse parenting impacts: an RCT in Brazil

Luciane R. Piccolo[1]✉, João B. A. Oliveira[2], Guilherme Hirata[3], Caitlin F. Canfield[1], Erin Roby[1] and Alan L. Mendelsohn[1]

BACKGROUND: To examine whether (1) a parent-child reading program (Universidade do Bebê [UBB]), conducted in Brazil pre-pandemic can support parenting and parent-child reading 6 months into the pandemic, (2) cognitive stimulation at pandemic onset mediates effects of UBB on these outcomes, and (3) UBB pre-pandemic buffers associations between COVID-19-related distress and parenting/parent-child reading 6 months into the pandemic.
METHODS: 400 women, either pregnant or with children 0–24 months, were randomized to UBB ($n = 200$) or control groups. UBB consisted of monthly parent workshops focusing on parent-child reading and a book-lending library. Assessments pre-pandemic (June-2019) and at pandemic onset (April-2020) included cognitive stimulation. Assessments 6 months into the pandemic (October-2020) included COVID-19 exposure/impact/distress, as well as parenting and parent-child reading.
RESULTS: 133 families ($n = 69$ UBB) contributed data 6 months into the pandemic. Participation in UBB pre-pandemic was associated with parent-child reading but not parenting 6 months into the pandemic. Indirect effects of UBB through cognitive stimulation at pandemic onset were observed for both outcomes. Increased COVID-19-related distress was significantly associated with reduced parenting/parent-child reading 6 months into the pandemic in the control group only.
CONCLUSION: Promotion of cognitive stimulation pre-pandemic may have reduced risk for effects of the pandemic on parenting/parent-child reading.
CLINICAL TRIAL REGISTRATION: The trial has been registered with the Brazilian Clinical Trials Registry RBR-29RZDH on 05/28/2018.

Pediatric Research; https://doi.org/10.1038/s41390-022-02419-8

IMPACT:

- This is the first study showing sustained impacts of a reading aloud intervention beginning in pregnancy and early infancy implemented pre-pandemic.
- Findings suggest that participation in a reading-aloud intervention buffered associations between COVID-19 distress and parenting/parent-child reading 6 months into the pandemic.
- Novel empirical evidence suggests that promotion of cognitive stimulation prior to the pandemic may buffer its impacts on parenting and parent-child book reading following onset in low- and middle-income countries.
- Findings provide important new support for implementation of parent-child reading aloud programs and likely have implications for early childhood development beyond the COVID-19 pandemic for disasters generally.

INTRODUCTION

As with previous disasters,[1–3] the COVID-19 pandemic may compound pre-existing stressors associated with poverty and exacerbate disparities in health and education, particularly in low- and middle-income countries (LMICs).[4,5] It has been projected that approximately 10 million children are at high risk for early developmental delays (90% of whom are from LMICs) and long-term deficits in educational and professional achievement due to childcare disruption during the COVID-19 pandemic.[4] Although these projections raise great concern, there has been limited research on strategies that may mitigate delays in early child development resulting from the pandemic, such as preventive parenting interventions, including those offered prior to the pandemic.[6]

Emerging studies have shown associations between COVID-19-related events (e.g., income loss, food insecurity, overcrowding, child care disruption),[7,8] as well as parenting and parents' mental health, particularly for families with infants and toddlers[9–17] and those with limited pre-existing resources.[13,15,18] For instance, parent stress related to the COVID-19 pandemic has been associated with harsh parenting[19,20] and changes in parent-child reading and playing routines,[21–23] resulting in adverse impacts on child cognitive-linguistic,[14,24–28] and psychosocial[29–31] development. These findings are consistent with conceptual models and

[1]Department of Pediatrics, Division of Developmental and Behavioral Pediatrics, NYU Grossman School of Medicine, 462 First Ave—Bellevue Hospital, New York, NY 10016, USA. [2]Instituto Alfa e Beto, 538 Lineu Anterino Mariano st, Uberlândia, MG 38402-346, Brazil. [3]IDados, 470 Visconde de Pirajá st., Rio de Janeiro, RJ 22410-002, Brazil.
✉email: Luciane.Piccolo@nyulangone.org

Received: 4 August 2022 Revised: 5 November 2022 Accepted: 21 November 2022
Published online: 15 December 2022

pre-pandemic evidence suggesting that both exposure to stressors and limited resources are major contributors to disparities in child development.[32–34] Specifically, this literature indicates that environmental stressors, similar to those related to the COVID-19 pandemic,[9,15,20,35] are associated with psychosocial vulnerabilities and relational health (i.e., parent-child relationship quality and parenting practices) and that resource deprivation may limit provision of cognitively stimulating materials and experiences in the home.[32–34]

Prior to the COVID-19 pandemic, many preventive early childhood development (ECD) programs focused on promotion of parenting and cognitive stimulation as a key strategy to prevent effects of stressors on relational health and child development.[34,36] For example, a reading aloud program called *Universidade do Bebê* (UBB), the focus of the current analysis, has undergone two studies in Brazil prior to the pandemic showing impacts on parenting (cognitive stimulation and quantity and quality of reading interactions) and child cognitive-linguistic and socioemotional outcomes in families with low income.[37,38] Emerging studies have suggested that these strategies may also mitigate early learning losses resulting from the COVID-19 pandemic.[39,40] Limited research on preventive programs focusing broadly on positive parenting and delivered pre-pandemic, such as Family Foundations (FF), has shown positive impacts on parenting and child behaviors in the early phase of the pandemic.[6] However, there is no empirical evidence to support participation in pre-pandemic reading aloud programs as a buffer to the COVID-19 pandemic impacts on parenting practices and parent-child reading aloud. The lack of longitudinal data on young children[41] (collected both pre- and post-pandemic) is also a barrier to making causal claims regarding impacts of interventions delivered prior to the pandemic and identifying potential protective factors.[27]

The current analysis seeks to address this limitation through longitudinal follow up of families in Brazil participating in a study of UBB, in which the program was delivered pre-pandemic.[38] We have previously reported findings of this study through pandemic onset, including positive impacts on cognitive stimulation.[38] Here, we seek to extend those findings by investigating: (1) whether UBB resulted in enhanced parenting and parent-child reading 6 months into the pandemic, (2) whether cognitive stimulation at pandemic onset and following termination of UBB mediated effects of UBB on parenting and parent-child book reading 6 months into the pandemic, and (3) whether UBB pre-pandemic buffered associations between COVID-19-related distress and parenting and parent-child reading 6 months into the pandemic. We hypothesized that participation in UBB pre-pandemic would have impacts on parenting and parent-child reading that would be sustained 6 months into the pandemic. We also hypothesized that this impact would be mediated by cognitive stimulation in the home at pandemic onset and that UBB would buffer negative effects of pandemic-related distress on parenting and parent-child reading aloud practices.

METHODS

Design

The current study was conducted in the context of a randomized controlled trial (RCT) investigating impacts of UBB on parenting and child outcomes in community centers in three neighborhoods in a city in northeast Brazil.[38] This study was approved by the Ethics Committee of the Instituto de Medicina Integral Professor Fernando Figueira in Brazil under protocol number 2.503.697. The trial has been registered with the Brazilian Clinical Trials Registry RBR-29RZDH on 05/28/2018. All participants provided informed consent.

Subjects

Families were eligible for the study if the mother was pregnant ($n = 66$) or had children 0–24 months (0–12 months, $n = 175$; 12–24 months, $n = 159$), and met income criteria (less than half minimum wage per capita and total less than 3 times minimum wage per household) for a conditional federal cash-transfer program in Brazil ("Bolsa Família").[42] Families enrolled in the RCT were also eligible to participate in a lottery to a home visiting program, called "Programa Criança Feliz" ("Happy Child Program"; PCF).[43]

There were no exclusion criteria. Enrollment and the randomization processes were described in a previous publication.[38] Four hundred families were randomized to UBB ($n = 200$) or control groups ($n = 200$) using a random number generator in Stata.

Intervention

The UBB intervention consisted of 1-h monthly parent workshops focused on parent-child shared reading that were led by a coach with a BA in psychology. The curricula included videos, live demonstrations, and practice of parent-child reading as well as discussion of strategies for reading with children at home and the importance of talking with children during reading, play, and daily routines. Parents were also encouraged to find a time to read with their child every day. Families in the UBB group also borrowed age-appropriate children's books at each meeting. Each week between workshops, a staff member delivered and collected the books at families' homes. The program was implemented from August 2019 to March 2020, at which time it was discontinued due to the pandemic.[38]

Procedures

Figure 1 shows the study flow diagram and timeline of research activities. Pregnant women and families with children 0–24 months participated in in-person interviews in June 2019 and phone interviews in April 2020. At these time points, they provided data on sociodemographic characteristics and parent-child reading aloud and play routines at home by responding to surveys validated for the Brazilian population and used in previous studies.[37,38] In October 2020, phone interviews were completed to assess COVID-19 exposure, impact, and related distress, as well as parenting practices and parent-child reading 6 months into the pandemic. The surveys and children's direct assessments were conducted by research assistants (blind to study hypotheses and group assignment). Specialists in child development translated COVID-19 questionnaires and evaluated items' relevance and semantic appropriateness for the Brazilian population.

Measures

Outcome

Parenting In a Pandemic Scale (PIPS; phone interviews in October 2020).[44]: This survey measures changes in parenting practices in terms of infection prevention, socioemotional support, and structured activities, including parent-child reading activities during the COVID-19 pandemic. It consists of 25 items using a 5-point Likert scale ranging from 0 (a lot less than before the pandemic) to 4 (a lot more than before the pandemic). Examples of items include "*Read books with my child*" and "*Ensured that my child has good quality sleep (e.g., regular sleep and wake times, no screens in bed)*". In this study, PIPS total score and a composite of 4 questions about parent-child reading were analyzed as continuous variables (range 0–4; high scores indicate increased positive parenting practices or parent-child reading during the pandemic). In this sample, the overall scale ($\alpha = 0.78$) and the parent-child reading composite ($\alpha = 0.88$) presented good internal consistency.

Predictors

COVID-19 Exposure and Family Impact Survey (CEFIS; phone interviews in October 2020).[45,46]: The CEFIS measures levels of exposure to COVID-19 and its impact on families' economic and psychosocial factors. Families were asked to respond to survey items considering events since March 2020. CEFIS has three domains: (1) Exposure, which consists of 25 Yes/No items corresponding to COVID-19-related events such as school closures, changes in employment, and exposure to the virus (scores 0–25); (2) Impact, which consists of 10 items rating COVID-19 impacts on family functioning factors using a 4-point Likert scale (1 = made it a lot better, 2 = made it a little better, 3 = made it a little worse, 4 = made it a lot worse, and a "not applicable" option); scale score is the average across items (range 1–4); and (3) Distress, which consists of 2 items measuring parents and children distress using a 10-point scale (0 = no distress to 10 = extreme distress); scale score is the average across items (range 0–10). High scores indicate high COVID-19

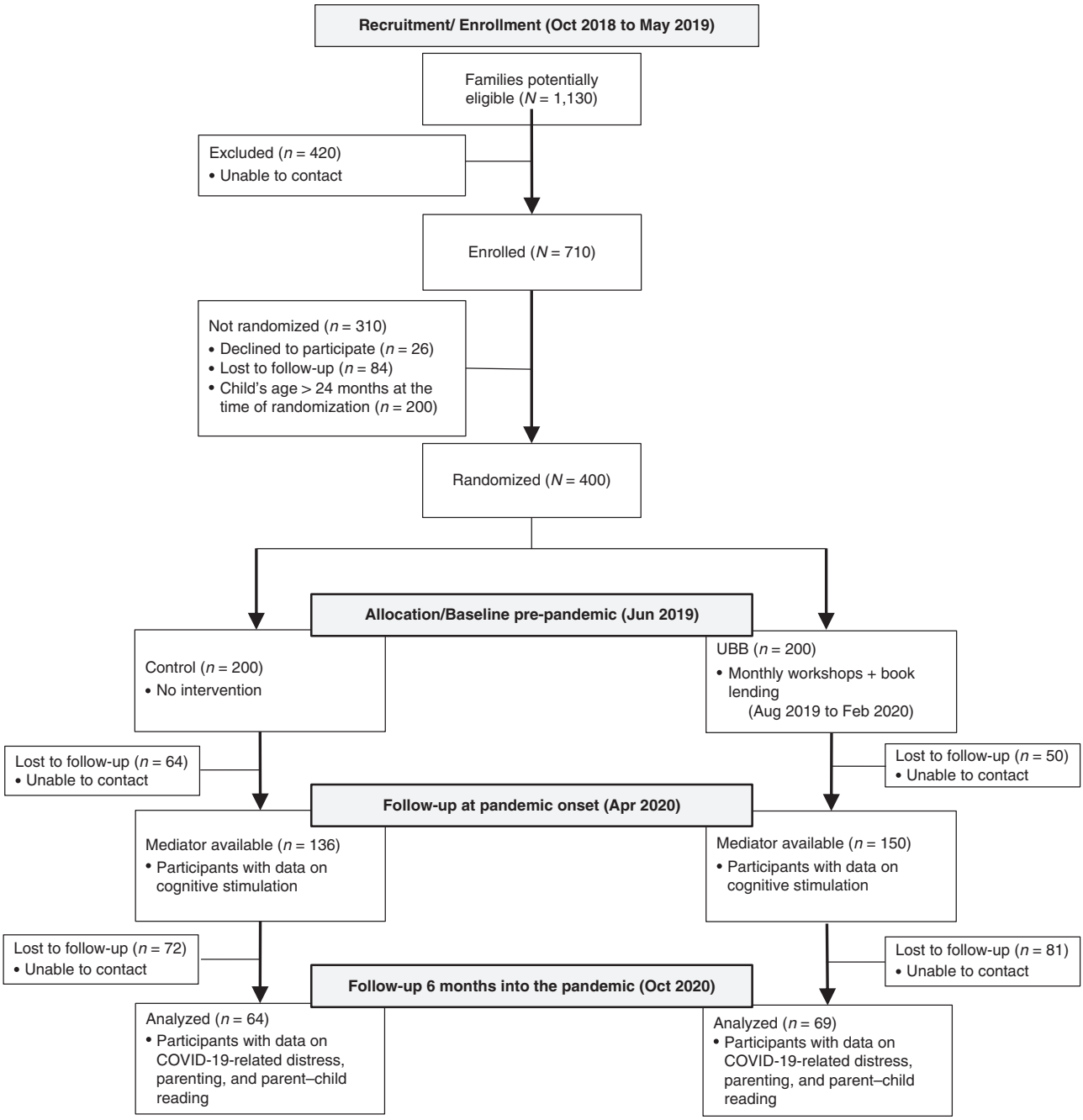

Fig. 1 Study flow diagram. Participant flow from eligibility assessment through enrollment, intervention, and data collection to completion of follow-up.

exposure/impact/distress. In this sample, the three subscales showed good ($\alpha = 0.75$ for Exposure, $\alpha = 0.81$ for Impact, and $\alpha = 0.76$ for Distress) internal consistency.

Mediator

StimQ (phone interviews in April 2020).[47]: The StimQ measures cognitive stimulation in the home through parent-child interactions in play, shared reading, teaching, and daily routines. We used the StimQ Core subscales, which include: (1) frequency and quality of reading interactions (READ; scores 0–13); (2) caregiver-child verbal interactions (Parental Verbal Responsivity [PVR]; scores 0–14); and (3) caregiver teaching and play activities (Parent Involvement in Developmental Advance [PIDA]; scores 0–10). In this study, the total score was analyzed. The Brazilian version showed high internal consistency ($\alpha = 0.95$) in a previous study.[38]

Covariates (in-person parent-surveys in June 2019). Child characteristics included child's age, sex, and birth order. Family characteristics included the mother's age, education (dichotomized as high school graduate or less), marital status, as well as household food insecurity and overcrowding (persons per room). Maternal depression was measured by the Edinburgh Postnatal Depression Scale (EPDS)[48] and dichotomized using total score ≥ 10 as a cutoff.[48,49] In addition, participation in the PCF home visiting program was scored dichotomously as 0 (control) or 1 (PCF offered by the municipality).

Data analysis

Analyses were based on intent-to-treat. Descriptive statistics were used to summarize participants' sociodemographic characteristics and to describe COVID-19 pandemic exposure and impacts on low-income families' well-being in northeast Brazil. Comparisons between the full and analytic

Table 1. Sample characteristics.

	Full sample ($N = 400$)	Analytic sample ($n = 133$)	p[a]	Randomization Group		p[b]
				Control ($n = 64$)	UBB ($n = 69$)	
Child characteristics at baseline						
Child's Age in Months, mean (SD)	11.6 (6.7)	10.7 (6.6)	0.09	10.3 (6.5)	11.0 (6.7)	0.56
Child Sex – Female, %	48.8	50.8	0.91	45.3	53.6	0.34
First Born Child, %	35.5	36.7	0.65	31.2	39.1	0.34
Family characteristics at baseline						
Mother's Age in Years, mean (SD)	27.3 (6.6)	27.7 (5.8)	0.33	28.5 (6.4)	27.0 (5.2)	0.13
Mother High School Graduate, %	45.5	51.3	0.40	52.0	60.0	0.35
Parents Married or Living with a Partner, %	67.9	70.8	0.14	73.4	72.4	0.90
Depression, %[c]	35.3	33.8	0.66	29.7	37.7	0.33
Food Insecure, %	73.0	82.0	0.30	81.2	76.8	0.50
Overcrowding, mean (SD)	0.9 (0.3)	0.8 (0.3)	0.13	0.8 (0.3)	0.8 (0.3)	0.61
Offered PCF, %	50.2	48.1	0.62	51.6	44.9	0.45
CEFIS 6 months into the pandemic						
Exposure, mean (SD)	–	10.1 (3.8)	–	10.0 (4.1)	10.2 (3.4)	0.79
Impact, mean (SD)	–	2.4 (0.5)	–	2.4 (0.5)	2.5 (0.4)	0.17
Distress, mean (SD)	–	6.1 (2.6)	–	5.9 (2.7)	6.2 (2.5)	0.48

CEFIS COVID-19 exposure and impact survey.
[a]p value for comparisons between Full and Analytic Sample (t-test for continuous variables and chi-square for categorical variables).
[b]p value for comparisons between Randomization Groups in the Analytic Sample (t-test for continuous variables and chi-square for categorical variables).
[c]Met criteria if EPDS ≥ 10.

samples as well as between randomization groups were conducted using chi-square (for dichotomous variables) and t-tests (for continuous indicators).

To address our first aim, we performed t-test and linear regression analyses (adjusted for covariates and CEFIS scores) to investigate whether UBB conducted pre-pandemic may support parenting and parent-child reading 6 months into the pandemic (PIPS).

For our second aim, we conducted mediation analysis using structural equation modeling (SEM) to understand whether cognitive stimulation (StimQ) following termination of UBB at pandemic onset mediates effects of UBB on parenting and parent-child reading 6 months into the pandemic (PIPS). Separate models for each of the dependent variables (i.e., parenting and parent-child reading - PIPS) were tested, adjusting for baseline covariates and cognitive stimulation (StimQ), as well as COVID-19 distress/impact/exposure scores (CEFIS). The "estat teffects" command in Stata was used to determine significance of all indirect effects for each model.

For our third aim, moderation analyses were performed to investigate whether UBB pre-pandemic may buffer associations between COVID-19 distress/impact/exposure (independent variable; CEFIS) and parenting and parent-child reading during the pandemic (dependent variables; PIPS) while controlling for covariates. Subgroup analyses were conducted to examine associations between CEFIS scores and parenting and parent-child reading (PIPS) by randomization group, when the interaction term UBB*CEFIS was significant.

In addition, we replicated the analyses by using multiple imputed data sets. Missing values of StimQ at pandemic onset ($n = 114$; UBB $n = 50$), CEFIS ($n = 267$; UBB $n = 131$), and PIPS ($n = 267$; UBB $n = 131$) were replaced using multiple imputation by randomization groups[50] and a confirmatory intent-to-treat analysis was conducted. Table 1 shows results before imputation (results after imputation are shown in the Supplementary Materials).

RESULTS

Sample characteristics

Enrollment took place from October 2018 through May 2019. The analytic sample consisted of 133 parents ($n = 69$ UBB) who responded to phone interviews in April and October 2020 with children 9.3 to 40.5 months (M = 24.8 months, SD = 8.1) at the time of the COVID-19 specific assessment in October 2020 (Fig. 1). The full ($N = 400$) and analytic ($n = 133$) samples had comparable sociodemographic characteristics at baseline (Table 1). In addition, sociodemographic characteristics of families lost to follow-up were comparable between randomization groups (Supplementary Materials, Table S1).

Randomization groups did not differ in terms of exposure and impact of COVID-19. Table 1 shows that families in this study were exposed to an average of 10.1 events related to the pandemic (CEFIS Exposure subscale). In terms of impacts, the mean score on CEFIS Impact subscale was close to the mid-point (2.5), indicating that overall families' well-being had not been significantly affected by the pandemic. For families in both groups, distress levels (CEFIS Distress subscale) were above the mean point (5). Similar results were found after imputation (see Supplementary Materials, Table S2).

Aim 1. Association between participation in UBB pre-pandemic and parenting and parent-child reading 6 months into the pandemic

Differences between UBB and control groups were significant for parent-child reading ($t(131) = 2.47$, $p = 0.01$; Cohen's $d = 0.36$) but not for parenting ($t(130) = 1.07$, $p = 0.28$; $d = 0.19$). Models adjusted for covariates showed that UBB was associated with parent-child reading ($\beta = 0.22$, $p = 0.03$) but not overall parenting ($\beta = 0.06$, $p = 0.33$) 6 months into the pandemic (Fig. 2). The association between UBB and parent-child reading 6 months into the pandemic was retained after adjusting for CEFIS Distress ($\beta = 0.22$, $p = 0.04$), Impact ($\beta = 0.25$, $p = 0.01$) or Exposure ($\beta = 0.22$, $p = 0.03$). Results were similar after data imputation (see Supplementary Materials).

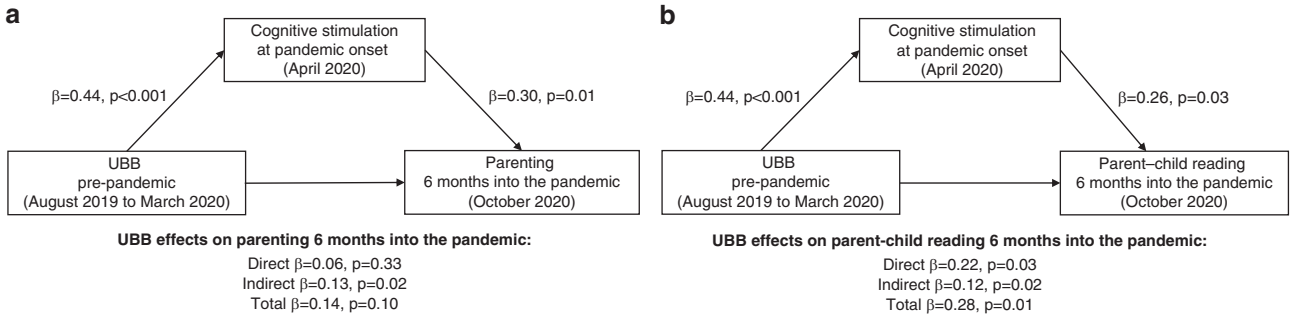

Fig. 2 Effects of UBB. Effects of UBB on **a** parenting and **b** parent–child reading 6 months into the pandemic, including total, direct, and indirect effects mediated by impacts on cognitive stimulation in the home at pandemic onset. β = standardized coefficients. Models were adjusted for baseline covariates and cognitive stimulation, as well as COVID-19-related Distress.

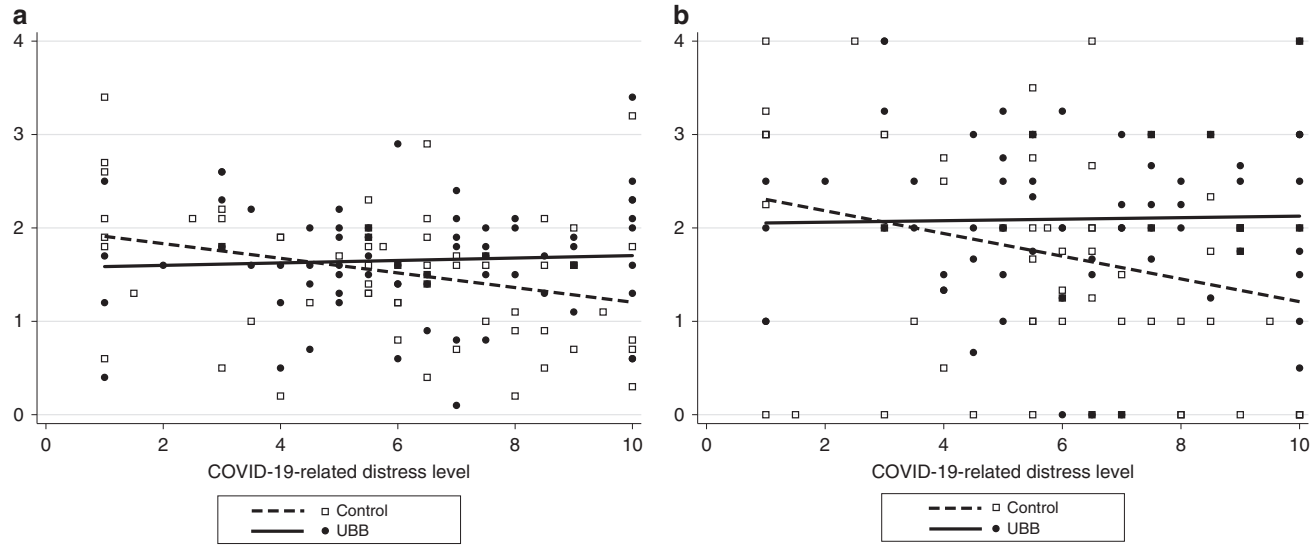

Fig. 3 UBB Moderated effects of COVID-19-related distress level on parenting and parent–child book reading 6 months into the pandemic. a, b The negative associations between COVID-19-related stress and parenting 6 months into the pandemic were buffered for the UBB group, but statistically significant for the control group. Models were adjusted for baseline covariates.

Aim 2. Cognitive stimulation at pandemic onset mediates effects of UBB on parenting and parent-child book reading 6 months into the pandemic

Indirect effects of UBB through cognitive stimulation at pandemic onset were observed for both parenting and parent-child book reading 6 months into the pandemic, in models adjusted for baseline covariates and cognitive stimulation as well as CEFIS Distress (Fig. 2). Results were similar when the models were adjusted for CEFIS Impact or CEFIS Exposure and when missing values were imputed (see Supplementary Materials, Table S3).

Aim 3. UBB pre-pandemic buffers associations between COVID-19 related distress and parenting and parent-child reading 6 months into the pandemic

Main effects of CEFIS Distress were significant for parenting ($\beta = -0.27$, $p = 0.01$) and parent-child reading ($\beta = -0.25$, $p = 0.03$). In addition, main effects of CEFIS Impact were observed for parenting ($\beta = -0.28$, $p = 0.01$) and parent-child reading ($\beta = -0.34$, $p = 0.002$) 6 months into the pandemic. There were no significant main effects of CEFIS Exposure. Results were similar after data imputation (see Tables S3 and S4 in Supplementary Materials).

A significant interaction was found for UBB and CEFIS Distress for both overall parenting ($\beta = 0.32$, $p = 0.024$) and parent-child reading ($\beta = 0.35$, $p = 0.020$) 6 months into the pandemic. Figure 3 shows that negative associations between COVID-19 Distress scale and parenting/parent-child reading were buffered for the UBB group (parenting: $\beta = -0.02$, $p = 0.91$; parent-child reading: $\beta = -0.14$, $p = 0.29$), but were significant for the control group (parenting: $\beta = -0.34$, $p = 0.014$; parent-child reading: $\beta = -0.45$, $p = 0.002$). That is, increased COVID-19 Distress was significantly associated with reduced positive parenting and parent-child reading 6 months into the pandemic in the control group only. Similarly, a significant interaction was also found for UBB and CEFIS Impact for overall parenting ($\beta = 0.39$, $p = 0.003$) and parent-child book reading ($\beta = 0.36$, $p = 0.006$) 6 months into the pandemic. Negative associations between COVID-19 Impact scale and parenting/parent-child reading were buffered for the UBB group (parenting: $\beta = -0.13$, $p = 0.44$; parent-child reading: $\beta = -0.16$, $p = 0.20$), but were significant for the control group (parenting: $\beta = -0.40$, $p = 0.01$; parent-child reading: $\beta = -0.35$, $p = 0.03$). There were no significant interactions for UBB and CEFIS Exposure (parenting: $\beta = -0.11$, $p = 0.38$; parent-child reading: $\beta = -0.07$, $p = 0.61$).

For brevity, we only illustrate the significant interactions between CEFIS Distress and UBB (Fig. 3). Results for all outcomes, including after imputation, are presented in Supplementary Materials (Tables S4 and S5).

DISCUSSION

This study demonstrated that (1) UBB showed sustained increased parent-child reading 6 months into the pandemic, (2) effects of UBB on parenting and parent-child book reading 6 months into the pandemic were mediated by cognitive stimulation at pandemic onset, and (3) participation in UBB pre-pandemic buffered links between COVID-19 related distress/impact and parenting practices and parent-child reading 6 months into the pandemic. Findings reinforce the importance of research on and implementation of parenting programs to support vulnerable populations, as they may not only address disparities, but prevent the exacerbation of such inequality during disasters, globally and particularly in LMICs.[2,3]

This study revealed a number of important results. First, our analyses demonstrate that participation in UBB beginning in pregnancy and early infancy, prior to the COVID-19 pandemic was associated with parent-child reading 6 months into the pandemic. This novel finding supports implementation of preventive programs focusing on parent-child reading aloud and contributes to limited literature[6] demonstrating how engaging in parenting interventions pre-pandemic showed benefits later during the COVID-19 pandemic.

Second, findings extend prior work showing the effects of UBB on cognitive stimulation[38] and demonstrate that these early impacts also mediate effects of UBB on parenting and parent-child reading, with effects sustained 6 months into the pandemic. These findings align with existing conceptual models,[32,34] and suggest that promotion of parent-child reading and provision of books beginning in pregnancy and early infancy supports early relational health and childhood development.

Finally, this study showed that significant effects of adverse childhood experiences (ACEs) associated with COVID-19[7,8,51] on parenting and parent-child reading were buffered by participation in a parent-child reading aloud program pre-pandemic. Research suggests that children who experience ACEs and are at greater risk for developmental problems may nonetheless thrive when they also experience positive parent-child interactions and relationships.[52] These findings are clinically important given that the pandemic and other natural disasters may have unique impacts on children's development as they not only exacerbate existing disparities and make ACEs more likely, but may also create barriers to positive childhood experiences and positive relational health that are known to support flourishing.[1–3,52] The current findings extend these results to ACEs associated with the COVID-19 pandemic,[51] and provide further evidence in support of recent American Academy of Pediatrics (AAP) statements on the importance of promotion of positive relational health.[36] Importantly, these results also highlight modifiable protective mechanisms for children's potential learning losses that are posited to result from the COVID-19 pandemic.[4,40] In addition, findings add to existing evidence of supporting a role for programs targeting positive parenting activities such as reading aloud and play (e.g., "Reach Out and Read" and "Video Interaction Project") in the context of traumatic events broadly. For example, a study in the Philippines suggested that support for reading aloud helped buffer experience of trauma following Typhoon Haiyan.[53]

This study used data from an RCT of parents of infants and toddlers in a LMIC to demonstrate strong empirical evidence of the impacts of a reading aloud program delivered pre-pandemic on parenting and parent-child reading 6 months into the pandemic. However, there are a number of limitations. First, validated measures to evaluate COVID-19 exposure/impacts and parenting practices in the context of the pandemic in Brazil were unavailable. We addressed this limitation by examining psychometric characteristics of the translated scales, which demonstrated good internal consistency. Second, approximately a third of the original cohort was interviewed for the assessment that took place 6 months following pandemic onset. However, comparison of sociodemographic characteristics did not show differences between the analytic and full samples. Further, analyses utilizing data imputation methods had comparable findings, with significant differences retained for all measures. Third, given that perceived pandemic-related distress may vary depending on the timing of the evaluation,[54] interpretations of this study's results may be restricted to the time-point when the data was collected (October 2020), which is considered the end of the first wave of the COVID-19 pandemic in Brazil.[55] Fourth, further study is needed to determine whether findings generalize to other regions in Brazil, LMICs or high-income countries. Fifth, additional information about siblings (e.g., ages, school grades) was not available. This is an important limitation as older siblings in the household may have influenced parenting and reading routines in the context of homeschooling during the pandemic.[56] To further examine the potential role of siblings, we re-ran all analyses using number of siblings, rather than first-born, as a covariate. Findings were similar in terms of statistical significance and effect sizes. Sixth, we did not use diaries to examine parent-child reading. Instead, we used parent surveys, similar to other studies during the pandemic.[22,23] Although our prior work has documented comparable findings when using StimQ and diaries,[57] no studies to our knowledge have examined parent-child reading through parents' diaries during the pandemic. Finally, this study's results allow only indirect evidence for the potential buffering effect of UBB on children's COVID-related learning losses.

Future studies should investigate whether programs that vary in intensity and focus might have similar buffering effects in the context of crises. In addition, such studies should investigate whether intervention impacts on early childhood development and families' wellbeing might differ depending on location, level of exposure to traumatic events, race/ethnicity, and existing family strengths/challenges.

CONCLUSION

This study indicated that promotion of cognitive stimulation in the home through parent-child reading pre-pandemic may be a useful strategy for buffering negative effects of COVID-19 on parenting and parent-child reading, with potential for preventing delays in early child development. These findings have implications for the design and implementation of preventive programs to support vulnerable families, within and beyond the COVID-19 pandemic context.

DATA AVAILABILITY

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

REFERENCES

1. Kammerbauer, M. & Wamsler, C. Social inequality and marginalization in post-disaster recovery: challenging the consensus? *Int. J. Disaster Risk Reduct.* **24**, 411–418 (2017).
2. do Carmo, R. F., Silva Júnior, J. V. J., Pastor, A. F. & de Souza, C. D. F. Spatio-temporal dynamics, risk areas and social determinants of dengue in Northeastern Brazil, 2014–2017: an ecological study. *Infect. Dis. Poverty* **9**, 153 (2020).
3. Diderichsen, F., Augusto, L. G., da, S. & Perez, B. Understanding social inequalities in Zika infection and its consequences: a model of pathways and policy entry-points. *Glob. Public Health* **14**, 675–683 (2019).
4. McCoy, D. C. et al. Global estimates of the implications of COVID-19-related preprimary school closures for children's instructional access, development, learning, and economic wellbeing. *Child Dev.* **92**, 13658 (2021).
5. Osendarp, S. et al. The COVID-19 crisis will exacerbate maternal and child undernutrition and child mortality in low- and middle-income countries. *Nat. Food 2021 27* **2**, 476–484 (2021).
6. Feinberg, M. E. et al. Building long-term family resilience through universal prevention: 10-year parent and child outcomes during the COVID-19 pandemic. *Fam. Process* **61**, 76–90 (2022).

7. Patrick, S. W. et al. Well-being of parents and children during the COVID-19 pandemic: a national survey. *Pediatrics* **146**, e2020016824 (2020).
8. Gagné, M.-H., Piché, G., Clément, M.-È. & Villatte, A. Families in confinement: a pre–post COVID-19 study. *Couple Fam. Psychol. Res. Pract.* **10**, 260–270 (2021).
9. Lucassen, N., de Haan, A. D., Helmerhorst, K. O. W. & Keizer, R. Interrelated changes in parental stress, parenting, and coparenting across the onset of the COVID-19 pandemic. *J. Fam. Psychol.* **35**, 1065–1076 (2021).
10. Kahn, M., Barnett, N., Glazer, A. & Gradisar, M. COVID-19 babies: auto-videosomnography and parent reports of infant sleep, screen time, and parent well-being in 2019 vs 2020. *Sleep. Med.* **85**, 259–267 (2021).
11. Layton, H., Owais, S., Savoy, C. D. & Van Lieshout, R. J. Depression, anxiety, and mother-infant bonding in women seeking treatment for postpartum depression before and during the COVID-19 pandemic. *J. Clin. Psychiatry* **82**, 21m13874 (2021). https://doi.org/10.4088/JCP.21m13874
12. Mayopoulos, G. A. et al. COVID-19 is associated with traumatic childbirth and subsequent mother-infant bonding problems. *J. Affect. Disord.* **282**, 122–125 (2021).
13. Hamadani, J. D. et al. Immediate impact of stay-at-home orders to control COVID-19 transmission on socioeconomic conditions, food insecurity, mental health, and intimate partner violence in Bangladeshi women and their families: an interrupted time series. *Lancet Glob. Heal.* **8**, e1380–e1389 (2020).
14. Provenzi, L. et al. Prenatal maternal stress during the COVID-19 pandemic and infant regulatory capacity at 3 months: a longitudinal study. *Dev. Psychopathol.* 1–9 (2021). https://doi.org/10.1017/S0954579421000766
15. Taubman, –, Ben-Ari, O., Ben-Yaakov, O. & Chasson, M. Parenting stress among new parents before and during the COVID-19 pandemic. *Child Abus. Negl.* **117**, 105080 (2021).
16. Fernandes, D. V., Canavarro, M. C. & Moreira, H. The role of mothers' self-compassion on mother–infant bonding during the COVID-19 pandemic: a longitudinal study exploring the mediating role of mindful parenting and parenting stress in the postpartum period. *Infant Ment. Health J.* **42**, 621–635 (2021).
17. Kimura, M., Kimura, K. & Ojima, T. Relationships between changes due to COVID-19 pandemic and the depressive and anxiety symptoms among mothers of infants and/or preschoolers: a prospective follow-up study from pre-COVID-19 Japan. *BMJ Open* **11**, e044826 (2021).
18. Prime, H., Wade, M. & Browne, D. T. Risk and resilience in family well-being during the COVID-19 pandemic. *Am. Psychol.* **75**, 631–643 (2020).
19. Fosco, G. M., Sloan, C. J., Fang, S. & Feinberg, M. E. Family vulnerability and disruption during the COVID-19 pandemic: prospective pathways to child maladjustment. *J. Child Psychol. Psychiatry* **63**, 47–57 (2022).
20. Sari, N. P., van IJzendoorn, M. H., Jansen, P., Bakermans-Kranenburg, M. & Riem, M. M. E. Higher levels of harsh parenting during the COVID-19 lockdown in the Netherlands. *Child Maltreat* **27**, 156–162 (2022).
21. López-Escribano, C., Escudero, A. & Pérez-López, R. An exploratory study about patterns of parental home literacy activities during the COVID-19 confinement among spanish families. *Early Educ. Dev.* **32**, 812–829 (2021).
22. Wheeler, D. L. & Hill, J. C. The impact of COVID-19 on early childhood reading practices. *J. Early Child. Lit.* 1–20 (2021). https://doi.org/10.1177/14687984211044187
23. Read, K., Gaffney, G., Chen, A. & Imran, A. The impact of COVID-19 on families' home literacy practices with young children. *Early Child. Educ. J.* 1–10 (2021). https://doi.org/10.1007/s10643-021-01270-6
24. Adegboye, D. et al. Understanding why the COVID-19 pandemic-related lockdown increases mental health difficulties in vulnerable young children. *JCPP Adv.* **1**, e12005 (2021).
25. Russell, B. S., Hutchison, M., Tambling, R., Tomkunas, A. J. & Horton, A. L. Initial challenges of caregiving during COVID-19: caregiver burden, mental health, and the parent–child relationship. *Child Psychiatry Hum. Dev.* **51**, 671–682 (2020).
26. Moore, S. A. et al. Impact of the COVID-19 virus outbreak on movement and play behaviours of Canadian children and youth: a national survey. *Int. J. Behav. Nutr. Phys. Act.* **17**, 85 (2020).
27. Spinelli, M., Lionetti, F., Pastore, M. & Fasolo, M. Parents' stress and children's psychological problems in families facing the COVID-19 outbreak in Italy. *Front. Psychol.* **11**, 1713 (2020).
28. González, M. et al. School readiness losses during the COVID-19 outbreak: a comparison of two cohorts of young children. *Child Dev.* **93**, 910–924 (2022).
29. Spinelli, M. et al. Parenting stress during the COVID-19 outbreak: Socioeconomic and environmental risk factors and implications for children emotion regulation. *Fam. Process* **60**, 639–653 (2021).
30. Babore, A. et al. Mothers' and children's mental health during the COVID-19 pandemic lockdown: the mediating role of parenting stress. *Child Psychiatry Hum. Dev.* 1–13 (2021). https://doi.org/10.1007/s10578-021-01230-6
31. Achterberg, M., Dobbelaar, S., Boer, O. D. & Crone, E. A. Perceived stress as mediator for longitudinal effects of the COVID-19 lockdown on wellbeing of parents and children. *Sci. Rep.* **11**, 2971 (2021).
32. Wolf, S. & McCoy, D. C. Household socioeconomic status and parental investments: direct and indirect relations with school readiness in Ghana. *Child Dev.* **90**, 260–278 (2019).
33. Masarik, A. S. & Conger, R. D. Stress and child development: a review of the Family Stress Model. *Curr. Opin. Psychol.* **13**, 85–90 (2017).
34. Shaw, D. S., Mendelsohn, A. L. & Morris, P. A. Reducing poverty-related disparities in child development and school readiness: the Smart Beginnings tiered prevention strategy that combines pediatric primary care with home visiting. *Clin. Child Fam. Psychol. Rev.* **24**, 669–683 (2021).
35. Westrupp, E. M. et al. Child, parent, and family mental health and functioning in Australia during COVID-19: comparison to pre-pandemic data. *Eur. Child Adolesc. Psychiatry* 1–14 (2021). https://doi.org/10.1007/s00787-021-01861-z
36. Garner, A. & Yogman, M. Preventing childhood toxic stress: Partnering with families and communities to promote relational health. *Pediatrics* **148**, e2021052582 (2021).
37. Weisleder, A. et al. Reading aloud and child development: A cluster-randomized trial in Brazil. *Pediatrics* **141**, e20170723 (2018). https://doi.org/10.1542/peds.2017-0723
38. Piccolo, L. R., Oliveira, J. B. A., Hirata, G., Duarte Neto, W. & Mendelsohn, A. L. Supporting reading aloud beginning prenatally and in early infancy: a randomized trial in Brazil. *J. Dev. Behav. Pediatr.* **43**, e590–e597 (2022). https://doi.org/10.1097/DBP.0000000000001118
39. Nuryanti, N. & Iswara, P. D. Home literacy environment: the solution to improve early reading skills of students in primary school during COVID-19. *Int. Conf. …* **3**, 219–228 (2021).
40. Bao, X., Qu, H., Zhang, R. & Hogan, T. P. Modeling reading ability gain in kindergarten children during COVID-19 school closures. *Int. J. Environ. Res. Public Health* **17**, 1–13 (2020).
41. Racine, N. et al. Global prevalence of depressive and anxiety symptoms in children and adolescents during COVID-19. *JAMA Pediatr.* **175**, 1142 (2021).
42. Rasella, D., Aquino, R., Santos, C. A. T., Paes-Sousa, R. & Barreto, M. L. Effect of a conditional cash transfer programme on childhood mortality: a nationwide analysis of Brazilian municipalities. *Lancet* **382**, 57–64 (2013).
43. Girade, H. A. 'Criança Feliz': A programme to break the cycle of poverty and reduce the inequality in Brazil. (2018).
44. Waller, R., Chester, M., Rodriguez, Y. & Wagner, N. Development of the Parenting In a Pandemic Scale (PIPS). (2020). https://doi.org/10.31234/osf.io/f8tzm
45. Enlow, P. T. et al. Validation of the COVID-19 exposure and family impact scales. *J. Pediatr. Psychol.* **47**, 259–269 (2022).
46. Kazak, A. E. et al. COVID-19 exposure and family impact scales: factor structure and initial psychometrics. *J. Pediatr. Psychol.* **46**, 504–513 (2021).
47. Dreyer, B. P., Mendelsohn, A. L. & Tamis-LeMonda, C. S. Assessing the child's cognitive home environment through parental report; reliability and validity. *Early Dev. Parent.* **5**, 271–287 (1996).
48. Santos, I. S. et al. Comparing validity of Edinburgh scale and SRQ20 in screening for post-partum depression. *Clin. Pract. Epidemiol. Ment. Heal.* **3**, 18 (2007).
49. Cox, J. L., Holden, J. M. & Sagovsky, R. Detection of postnatal depression: development of the 10-item Edinburgh postnatal depression scale. *Br. J. Psychiatry* **150**, 782–786 (1987).
50. Sullivan, T. R., White, I. R., Salter, A. B., Ryan, P. & Lee, K. J. Should multiple imputation be the method of choice for handling missing data in randomized trials? *Stat. Methods Med. Res.* **27**, 2610 (2018).
51. Jiao, W. Y. et al. Behavioral and emotional disorders in children during the COVID-19 epidemic. *J. Pediatr.* **221**, 264–266.e1 (2020).
52. Bethell, C. D., Gombojav, N. & Whitaker, R. C. Family resilience and connection promote flourishing among US children, even amid adversity. *Health Aff.* **38**, 729–737 (2019).
53. Agustin, M. S., Ramos-Bonoan, C., Lorenzana, R., Klass, P. & Needlman, R. Picture books and reading aloud to support children after a natural disaster: an exploratory study *Int. J. Emerg. Ment. Heal. Hum. Resil.* **21**, 1–6 (2018).
54. Park, C. L. et al. Psychological resilience early in the COVID-19 pandemic: stressors, resources, and coping strategies in a national sample of Americans. *Am. Psychol.* **76**, 715–728 (2021).
55. Zeiser, F. A. et al. First and second COVID-19 waves in Brazil: A cross-sectional study of patients' characteristics related to hospitalization and in-hospital mortality. *Lancet Reg. Heal. - Am.* **6**, 100107 (2022).
56. Sun, X. et al. Implications of COVID-19 school closures for sibling dynamics among U.S. Latinx children: a prospective, daily diary study. *Dev. Psychol.* **57**, 1708–1718 (2021).
57. Mendelsohn, A. L. et al. Primary care strategies for promoting parent-child interactions and school readiness in at-risk families. *Arch. Pediatr. Adolesc. Med.* **165**, 33–41 (2011).

ACKNOWLEDGEMENTS

We would like to thank Dr. Adriana Weisleder (Northwestern University) for contributing to the design of the study in Brazil. We also would like to thank Mariana Leite (IDados) for providing technical support to this study, Walfrido Duarte Neto and Danubia Santos (Instituto Alfa e Beto) for supervising fieldwork and coordinating parent workshops, as well as the intervention and evaluation teams for making the study possible. We are also thankful to the local authorities, as well as to the participating families.

AUTHOR CONTRIBUTIONS

L.R.P. drafted the initial manuscript, conceptualized and designed the study, designed the data collection instruments, conducted statistical analyses, and reviewed and revised the manuscript; J.B.A.O. conceptualized and designed the study, coordinated the implementation of the intervention in Brazil, and critically reviewed the manuscript; G.H. coordinated and supervised recruitment, enrollment, randomization, as well as data collection, conducted statistical analyses, and reviewed and revised the manuscript; C.F.C. and E.R. conceptualized and designed the study, and reviewed and revised the manuscript; A.L.M. conceptualized and designed the study, developed the intervention, designed the data collection instruments, and reviewed and revised the manuscript. All authors approved the final manuscript as submitted.

FUNDING

Instituto Alfa e Beto.

COMPETING INTERESTS

The authors declare no competing interests.

INFORMED CONSENT

Informed consent was obtained from the pregnant women and parents of the children at enrollment.

ADDITIONAL INFORMATION

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s41390-022-02419-8.

Correspondence and requests for materials should be addressed to Luciane R. Piccolo.

Reprints and permission information is available at http://www.nature.com/reprints

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.