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Rising stars in child mental health and interventions

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Rising stars in child mental health and interventions

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Editorial: Rising stars in child mental health and interventions

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KEYWORDS

child mental health, interventions, school, psychotherapy, emotional regulation, caregivers

Editorial on the Research Topic
Rising stars in child mental health and interventions

We are pleased to introduce Frontiers Research Topic—*Rising stars in child mental health and interventions*. This collection of articles includes 12 original papers authored by 81 authors and an intentionally broad array of topics highly relevant to the field of child and adolescent psychiatry. It is no secret that children and adolescents' mental health and wellbeing have received significant public attention in recent years, following documented increases in depression, anxiety, and neurodevelopmental disorders. As articulated in the US Surgeon General Advisory on protecting youth mental health, the COVID-19 pandemic enhanced youth's pre-existing challenges and increasing rates of psychological distress, especially in already vulnerable populations. The advisory concluded that maintaining health children and families requires all of society to take part in this effort (1). The United Nations unicef and the World Health Organization have also highlighted youth mental health as a global challenge, which affects young people in every part of the world, causing significant suffering (2, 3). As such, we are encouraged that the themes of this research topic suggest that new and exciting opportunities to improve children and adolescents' mental health are occurring in many setting where youth are cared for, and that enhancing the scientific knowledge in mental health and allied fields is *a priority*. We would like to reflect on some of the themes that emerged for us while editing this topic.

Children and adolescent spend many hours in school and educational environments, and educators and other professional staff at school are important in noticing and reporting on any concerns in both typically developing youth and those with diagnosed developmental or behavioral health conditions. Using educational settings to assess social skills and predict depression has been an important component of the work of Krygsman et al. who report on *depression symptoms, communication and cooperation skills, and friendship: longitudinal associations in young Norwegian children*. Their findings suggest a relationship between depressive symptoms in preschool, the development of early social skills and friendships, and later childhood depression. In a study delivering an intervention in an elementary school setting, Leger-Goodes et al. describe *feasibility, acceptability, and perceived benefits of a creative arts intervention for elementary school children living with speech, language and communication disorders*. Their pilot work suggests acceptability of this model by educational teams as well as potential benefits for student's emotional expression.

While the evidence base for psychotherapeutic approaches to youth's behavioral health challenges are expanding, one challenge for practicing clinicians is that most of these interventions are studied in academic settings. Therefore, the work done by the two following groups of researchers adapting and testing treatment protocols to and in diverse settings, internationally or in correctional settings, are highly important in bridging these gaps. Dozio et al. reported on *comparing the effectiveness of narrative therapy and EMDR-GTEP protocols in the treatment of post-traumatic stress in children exposed to humanitarian crises*. Their study which was conducted with children in the Central African Republic suggests that both protocols are effective in reducing symptoms of traumatic exposure and can be conducted by trained paraprofessionals. Given that many parts of the world are currently experiencing humanitarian crises situations for various reasons, this is a highly relevant study. Similarly, while dialectical behavioral therapy has a significant evidence base for the treatment of emotional dysregulation in adolescents with several mental health diagnosis, it has not been shown to be effective or feasible in correctional settings. Folk et al. have shown in their pilot study that *comprehensive dialectical behavior therapy for adolescents in a juvenile correctional treatment center* is a promising intervention that can be implemented with success.

Smith et al. are offering an important contribution to the evidence-based approaches to serious mental illness in youth, reporting on *alternative psychopharmacologic treatments for pediatric catatonia: a retrospective analysis*.

Several studies included in this collection provide insights into how tailored interventions can reduce anxiety, stress, emotional dysregulation, and other mental health issues among youth and their caregivers.

Caregivers play a central role in managing the mental health of anxious children, and recent studies emphasize the need to support caregivers' well-being alongside that of their children. Raftery-Helmer et al. highlight the effectiveness of Acceptance and Commitment Therapy for Parents of Anxious Children (ACT-PAC), which reduces caregivers' stress and cognitive challenges linked to child anxiety. By addressing these caregiver-specific issues, the study shows improvements in both caregiver mental health and child anxiety, underscoring the interconnectedness of their well-being.

Similarly, Huffman et al. found that when children undergo digital mental health interventions (DMHIs) such as behavioral coaching and therapy, caregivers also experience significant benefits. Caregivers reported improvements in sleep and reduced stress levels, demonstrating that addressing children's mental health has positive effects for the entire family, emphasizing the value of family-centered mental health care that includes caregivers in the therapeutic process.

As climate change becomes an increasing concern, studies are beginning to focus on the mental health impacts of ecological issues, particularly among young people. Malboeuf-Hurtubise et al. explore the growing phenomenon of eco-anxiety in youth, showing that positive psychology interventions can help mitigate feelings of hopelessness by fostering resilience, hope, and meaning-making. By encouraging young people to transform their anxiety into proactive engagement with environmental issues, this approach offers an innovative way to support youth mental health in the face of global challenges.

Maternal health, particularly during pregnancy and early childhood, has a profound impact on the long-term mental health of children. Jalnapurkar et al. emphasize that maternal physical and mental health conditions, as well psychosocial challenges, are linked to higher rates of anxiety and depression in extremely low gestational age newborns after 15 years. Their findings highlight the importance of early interventions aimed at improving maternal health, which in turn can significantly reduce the risk of psychiatric disorders in their children. This research underscores the need for preventive mental health strategies that extend beyond the child to include maternal and early-life factors.

When it comes to managing emotional dysregulation and ADHD in children, multidimensional interventions are showing promising results. Villagomez et al. investigate the role of broad-spectrum micronutrients (BSMs) in improving emotional regulation in psychiatric conditions like ADHD and mood disorders. Their research suggests that BSMs offer a complementary approach to traditional psychiatric treatments, contributing to more effective emotional management. In another study, Luo et al. explored the combination of behavior modification training and EEG biofeedback to treat children with ADHD. Their research demonstrated significant improvements in core symptoms such as hyperactivity, impulsivity, and inattention, particularly when both methods were used together. This comprehensive approach, integrating behavioral and neurological interventions, highlights the potential of multi-modal treatments for managing complex psychiatric conditions like ADHD.

The findings from these studies highlight the need for holistic, multidimensional approaches to mental health care while considering the well-being of both children and caregivers.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Alternative psychopharmacologic treatments for pediatric catatonia: a retrospective analysis

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Introduction: Pediatric catatonia is a highly co-morbid condition with treatment options often limited to electroconvulsive therapy (ECT) or lorazepam. However, lorazepam may not be readily available, and access to ECT is limited by restrictive legislation and stigma. This study aims to provide alternative treatment options for pediatric catatonia.

Methods: The study involved a single-site retrospective analysis of a private university hospital in the southern United States. The study included patients under eighteen with catatonia who received psychopharmacologic treatment with an agent other than lorazepam. The patients were evaluated with the Bush-Francis Catatonia Rating Scale (BFCRS), Kanner Catatonia Severity Scale (KCS), and Kanner Catatonia Examination (KCE) at the time of initial evaluation and upon stabilization. A retrospective clinical global impressions-improvement (CGI-I) score was assigned by four authors.

Results: 102 pediatric patients diagnosed with catatonia were identified, and 31 met criteria for the study. 20 (65%) were white, 6 (19%) were Black, 4 (13%) were Hispanic, and 1 (3%) were Indian. Most patients ($N = 18$; 58%) were insured by Medicaid. The mean age at the time of catatonia diagnosis was 13.5 years. All patients were stabilized on either clonazepam or diazepam, with 21 (68%) requiring treatment with an additional medication of either an anti-epileptic, N-methyl-D-aspartate (NMDA) receptor antagonist, and aripiprazole or clozapine. Statistically significant reductions in the BFCRS [$t = 11.2$, df = 30, std = 6.3, $p < 0.001$, 95% CI = (7.8, 15.1)], KCS [$t = 4.6$, df = 38, $p < 0.001$, 95% CI = (12.0, 31.0)], and KCE [$t = 7.8$, df = 30, std = 1.8, $p < 0.001$, 95% CI = (1.9, 3.2)] were observed. For CGI-I the results showed that the estimated probability of observing a score better than no change (>4) is 0.976 [t.s. = 43.2, $p < 0.001$, 95% CI = (0.931,0.992)], indicating the average subject is expected to experience some improvement.

Abbreviations

NDD, neurodevelopmental disorder; ECT, electroconvulsive therapy; NMDA, N-methyl-D-aspartate; BFCRS, bush-francis catatonia rating scale; KCRS, kanner catatonia rating scale; KCS, kanner catatonia severity; KCE, kanner catatonia examination; CGI-I, clinical global impressions-improvement; SD, standard deviation; CAP-CL, child and adolescent psychiatry consult-liaison; ADHD, attention deficit hyperactivity disorder; EI, excitatory inhibitory; AIC, intellectually capable persons with autism; AID, autism with intellectual disability.

Discussion: In conclusion, all patients responded to these treatments with improvement in their catatonic symptoms. Alternative pharmacologic interventions for catatonia, including benzodiazepines other than lorazepam, valproic acid, NMDA receptor antagonists, and atypical antipsychotics were safe and effective in treating catatonia in this population.

KEYWORDS

pediatric catatonia, electroconvulsive therapy, benzodiazepines, pediatric psychopharmacology, consult liaison

1. Introduction

Catatonia is a psychomotor disorder with affective domains and distinct physical examination findings. In adults, catatonia has been described in individuals with a range of psychiatric and medical conditions (1). Recently, evidence has suggested that catatonia may present differently in children, particularly those with developmental disorders (2, 3). Compared to catatonia in neurotypical adults, catatonia in children and those with co-morbid neurodevelopmental disorders (NDD) can present distinct symptoms and physical examination findings, which may increase the risk of a missed diagnosis. Examples of symptoms unique to pediatric catatonia include urinary incontinence, loss of previously acquired skills/communicative abilities, acrocyanosis, automatic compulsive movements, and schizophasia (4–6). Externalizing symptoms such as physical aggression, recurrent self-injury, and negativism may also be more common in pediatric and neurodevelopmental catatonia (7, 8), leading to difficulties obtaining a complete physical examination. These diagnostic challenges are of clinical concern as a missed diagnosis of catatonia may result in worsening/ongoing aggression and/or progression to malignant catatonia, a condition associated with autonomic instability and mortality rates as high as 10%–20% if left untreated (5). In addition, pediatric catatonia has been associated with a greater than sixty-fold higher risk of death than the general population (9). Thus, rapid identification and treatment of catatonia in children of diverse neurodevelopmental backgrounds is critical.

Per the 2023 consensus guidelines from the British Association for Psychopharmacology, high-dose lorazepam and electroconvulsive therapy (ECT) are considered the gold standard of catatonia treatment for adults and children (10). Despite ECT's clinical effectiveness in catatonia, access is often limited due to a lack of provider availability, stigma, and state-dependent legislation restricting ECT access for children (11). During the international lorazepam shortage of 2022, providers faced significant limitations in therapeutic options for treating catatonia, particularly providers without ready access to ECT. Due to limited research of alternative treatments for pediatric catatonia, this critical shortage posed a significant challenge in managing this severe and life-threatening condition. Research in adults supports alternative psychopharmacologic treatments for catatonia, including N-methyl-D-aspartate (NMDA) receptor antagonists, anti-epileptics, aripiprazole, and clozapine (12). In addition, preliminary work supports the use of alternative benzodiazepines in pediatric catatonia (13, 14). However, in the pediatric literature, only three case reports have been published supporting alternative pharmacologic approaches other than ECT and benzodiazepines. These specific reports include one case of memantine use (15), and two supporting treatment with amantadine (16, 17). Overall, while many case reports are published that discuss the treatment of catatonia, there are few well-powered research studies (18), an issue that is doubly compounded in pediatric catatonia (5, 19). Thus, greater research in this area is urgently needed.

This study presents a single-site retrospective analysis of pediatric catatonia patients who were treated with medications other than lorazepam and assesses the safety and efficacy of such agents in the treatment of pediatric catatonia. Overall, we aim to expound on the current literature in the field of pediatric catatonia and provide alternative treatment options for providers managing this highly morbid condition.

2. Materials and methods

Strengthening the Reporting of Observational Studies in Epidemiology guidelines were followed in our study (20). Using the SlicerDicer software found within the Epic Systems electronic medical record (21), we conducted a single-site retrospective analysis of a private university hospital in the southern United States. Treatment settings included in this study were a pediatric medical inpatient unit, a pediatric inpatient psychiatric unit, or a psychiatric outpatient clinic specializing in treating catatonia in neurodevelopmental disorders. The study period was from 08/17/2021 to 11/17/2022. The inclusion criteria for this study were as follows: (1) receiving a diagnosis of catatonia per the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders from a child and adolescent psychiatrist (22), (2) documented use of either the Bush-Francis Catatonia Rating Scale (BFCRS) (23) or Kanner Catatonia Rating Scale (KCRS) to confirm the diagnosis of catatonia at the time of initial evaluation and to assess for improvement at follow-up (24), (3) were under 18 years old at the time of diagnosis, and (4) received psychopharmacology treatment for catatonia with an agent other than lorazepam. Patients were excluded if their catatonia was managed with lorazepam monotherapy. To investigate how catatonia impacts individuals of varying backgrounds, data on age, Medicaid status, biological sex, race, ethnicity, psychiatric diagnoses, and psychopharmacologic history were collected. The institutional review board of Vanderbilt University Medical Center approved and oversaw this retrospective study (#220898) with a waiver of informed consent.

2.1. Symptom assessment

Catatonia was assessed using the BFCRS and/or KCRS for all patients. The KCRS was used in this study as it is designed to capture catatonic symptoms in individuals with varying neurodevelopmental backgrounds. Compared to the BFCRS, the KCRS places greater emphasis on reduced oral intake and externalizing behaviors, both symptoms of catatonia more common in pediatrics and those with NDDs. The KCRS includes a severity scale (KCS) and a standardized physical examination (KCE) (24). For patients seen via telemedicine, catatonia rating scales were calculated after observing parents and/or primary caregivers conduct the BFCRS, and KCE, and report specific symptoms over video (25).

2.2. Statistical analysis

For each patient included in the study, we obtained a retrospective clinical global impressions-improvement (CGI-I) score (26) assigned by the following authors: JRS, IB, TY, and CA. The CGI-I score was determined after each author reviewed the following components of the patient's medical record: inpatient and outpatient progress notes, ECT procedural documentation, inpatient and outpatient admission/intake notes, and consult the documentation. Each author was blinded to the results determined by their co-authors; thus 4 separate retrospective CGI-I scores were computed for each patient. Interrater reliability of the retrospective CGI-I score was calculated using Gwet's AC_2. Using CGI-I data, we fit an ordinal GEE model to investigate the probability of observing improvement (a CGI-I score greater than (4) while accounting for intra-rater correlation. Baseline BFCRS, KCS, and KCE scores were compared to scores at the end of treatment using paired *t*-tests. All tests were 2-sided, with a prespecified significance threshold of $p < 0.05$, without correction for multiple testing. Clinical response was defined as an average retrospective CGI < 4 measured by all four raters.

3. Results

3.1. Case selection

A total of one hundred and two pediatric patients with a catatonia diagnosis were identified. Thirty-one patients (31%) met the criteria for our study. Our analysis identified 7 (23%) patients most recently evaluated by telemedicine. For 2 (6.5%) patients, the KCRS was not done during the initial evaluation. Thus, KCRS scores were retrospectively obtained based on data reported in the BFCRS and the subjective portions of the initial evaluation.

3.2. Patient demographics, diagnoses, psychopharmacologic medication history, and baseline speaking Status

A total of thirty-one pediatric patients with catatonia met the inclusion criteria. Sample demographics, insurance status, historic diagnoses, psychopharmacologic history, history of seizures, and baseline verbal ability can be found in **Table 1**. The mean age at the time of catatonia diagnosis was 13.5 years, with a median of 15 years and a standard deviation (SD) of 3.6. 20 (65%) patients were *white*, 6 (19%) were *Black*, 4 (13%) were *Hispanic*, and 1 (3.2%) were *Indian*. The majority of patients ($N = 18$; 58%) were insured by Medicaid. Diagnostically, 26 patients (84%) had a neurodevelopmental disorder diagnosis prior to the onset of catatonia. These include 20 (65%) with a diagnosis of autism spectrum disorder, and 16 (52%) met the criteria for autism with profound impairment based on symptomology per the Lancet Commission definitions of profound autism (27). 2 of 16 (13%) patients with profound autism were under the age cut-off of eight years but were included in this group due to the severe nature of their symptoms. At baseline, 15 patients (48%) experienced baseline impairments in their verbal ability, including 8 (26%) who were non-speaking and 7 (23%) who were minimally verbal based on recent definitions described in meta-analytic work by Koegel and colleagues (28). Four patients had known genetic diagnoses. Previous trials of psychiatric medications were common in the sample. As outlined in **Table 1**, 23 (80%) of patients had been previously prescribed psychiatric medication, with a mean of 4.5 and a median of 3 prior medication trials.

3.3. Clinical setting and acute factors leading to catatonia onset

Table 2 includes data regarding the clinical location where catatonia was first identified, along with acute factors leading to the onset of catatonia. 27 patients (87%) were diagnosed with catatonia in the inpatient setting, while 4 (13%) were diagnosed as outpatients. Of the 27 diagnosed as an inpatient, 26 of the 27 inpatients (96%) were first identified by the pediatric medical hospital's child and adolescent psychiatry consult liaison (CAP-CL) service, and 1 of the 27 (3.7%) were identified in the inpatient psychiatric unit. 4 patients (13%) had an acute medical condition attributed to the onset of catatonia. These medical conditions included seronegative auto-immune encephalitis ($N = 2$; 6.5%), anti-NMDA receptor encephalitis ($N = 1$; 3.2%), and delirium ($N = 1$; 3.2%). In addition, 2 (6%) were prescribed a methylphenidate product to treat attention deficit hyperactivity disorder (ADHD) before admission. Notably, both patients were stimulant naïve at the time of methylphenidate administration. One patient developed catatonic symptoms after using cannabis. Psychiatric diagnoses associated with catatonia were present for 6 patients (19%). These include psychotic disorders ($N = 4$; 13%), bipolar 1 disorder ($N = 2$; 6.5%) 25 patients (81%) had a partial response to lorazepam (**Supplementary Table S1**, available online). With lorazepam treatment, 13 patients (42%) experienced breakthrough catatonic symptoms prior to the next lorazepam dose when dosed every six or every four hours.

Regarding additional acute precipitating factors, 9 (29%) patients experienced events described as stressful or traumatic by either the patient or their caregivers before the onset of catatonia. Specific examples include the following: 2 experienced the birth of a

TABLE 1 Patient demographics, diagnoses, psychopharmacologic medication history, and speaking status.

Demographics					
Biological sex and age		Ethnicity		Insurance coverage	
Male	19/31 (59%)	*White*	20/31 (65%)	Medicaid	18/31 (58%)
Female	13/31 (41%)	*Black*	6/31 (19%)	Private Insurance	13/31 (42%)
Mean Age	Mean = 13.5 years, SD = 3.6	*Hispanic*	4/31 (13%)		
		Indian	1/31 (3%)		
Historic diagnoses and psychopharmacologic trials					
Neurodevelopmental diagnoses		Genetic diagnoses		Psychopharmacologic medication history	
Total with neurodevelopment co-morbidity	26/31 (84%)	*NBEA* variant	1/31 (3%)	Total number of patients who were previously prescribed psychiatric medications	24/31 (80%)
Autism with Profound Impairment	16/31 (52%)	Fragile × Syndrome	1/31 (3%)	Mean and median number of failed psychiatric medications	Mean = 4.5, Median = 3 (Min = 1, Max = 14, SD = 3.6)
Autism without Profound Impairment	4/31 (13%)	22q11.2 Deletion Syndrome	1/31 (3%)	Mean number of failed second-generation antipsychotics	Mean = 1.5 (Min = 0, Max = 5, SD = 1.3)
Intellectual Disability Disorder	4/31 (13%)	Trisomy 10	1/31 (3%)	Mean number of failed first-generation antipsychotics	Mean = 0.3 (Min = 0, Max = 2, SD = 0.6)
Unspecified Neurodevelopmental Disorder	2/31 (6%)			Mean number of failed mood-stabilizers	Mean = 0.4 (Min = 0, Max = 2, SD = 0.6)
				Mean number of failed NMDA antagonists	Mean = 0.17 (Min = 0, Max = 1, SD = 0.4)
Seizure history and baseline verbal ability					
History of seizures		Baseline verbal ability			
Total number of patients with a history of seizures	10/31 (32%)	Non-speaking	8/31 (26%)		
		Minimally verbal	7/31 (23%)		

TABLE 2 Clinical setting and acute factors leading to catatonia onset.

Clinical setting where catatonia was diagnosed	
Inpatient	27/31 (87%)
Outpatient	4/31 (13%)
Inpatient setting where first diagnosed with catatonia	
Inpatient pediatric medicine by CAP consult-liaison psychiatry	26/27 (96%)
Inpatient pediatric psychiatry	1/27 (4%)
Acute medical condition at the time of catatonia diagnosis and treatment	
Seronegative autoimmune encephalitis	2/31 (6%)
Anti-NMDA receptor encephalitis	1/31 (3%)
Delirium	1/31 (3%)
Substance exposure preceding onset of catatonia	
Methylphenidate	2/31 (6%)
Cannabis	1/31 (3%)
Psychiatric co-morbidities contributing to onset of catatonia	
Total with previous psychiatric diagnoses	6/31 (19%)
Unspecified schizophrenia spectrum and other psychotic disorder	3/31 (10%)
Bipolar disorder, type 1	2/31 (6%)
Childhood-onset schizophrenia	1/31 (3%)
Stressful or traumatic event preceding onset of catatonia	
Total number of patients with traumatic exposure prior to catatonia onset	9/31 (29%)

younger sibling, 2 were physically assaulted, 1 moved across the country with family, 1 developed catatonia following surgery to repair scoliosis, 1 experienced cardiac arrest resulting in delirium followed by catatonia, and 1 was placed in physical restraints while at school. Of these nine patients, 8 of 9 (88%) carried a historical diagnosis of intellectual disability. The only patient in this sample without a history of intellectual disability developed catatonia in the setting of cardiac arrest and delirium.

3.4. Acute psychopharmacologic treatments of pediatric catatonia

As defined by inclusion criteria, all 31 patients were treated with either clonazepam or diazepam. As reported in Table 3, clonazepam was the most commonly prescribed benzodiazepine, with 27 patients (87%) receiving this agent (mean = 7.0 mg, SD = 7.1). The remaining 4 patients (13%) received diazepam (mean = 161 mg, SD = 28 mg). Despite the high dosage of benzodiazepines, no adverse effects were reported, including respiratory suppression. Per Figure 1, 10 patients (32%) were treated only with clonazepam or diazepam. However, incomplete treatment response was experienced by 21 (68%) patients in this sample. Therefore, alternative pharmacologic

TABLE 3 Summary of alternative acute psychopharmacologic treatment of pediatric catatonia

Pharmacologic Intervention	Medication class	Total number of patients using the medication	Mean (SD) total daily dosage	Median total daily dosage	Range of total daily dosage
Clonazepam	Benzodiazepine	27/31 (87%)	7 mg (7.1)	6.9 mg	0.8 mg–24 mg
Diazepam	Benzodiazepine	4/31 (13%)	161.3 mg (28.4)	172.5 mg	120 mg–180 mg
Memantine	NMDA Receptor Antagonist	12/31 (39%)	17.7 mg (6.2)	5.8 mg	5 mg–25 mg
Amantadine	NDMA Receptor Antagonist	1/31 (3%)	150 mg	–	–
Valproic Acid	Anti-epileptic	4/31 (13%)	1050 mg (665.8)	576.6 mg	500 mg–2000 mg
Oxcarbazepine	Anti-epileptic	2/31 (6%)	300 mg	–	–
Aripiprazole	Atypical Antipsychotic	3/31 (10%)	10 mg (5)	5 mg	5 mg–15 mg
Clozapine	Atypical Antipsychotic	1/31 (3%)	300 mg	–	–

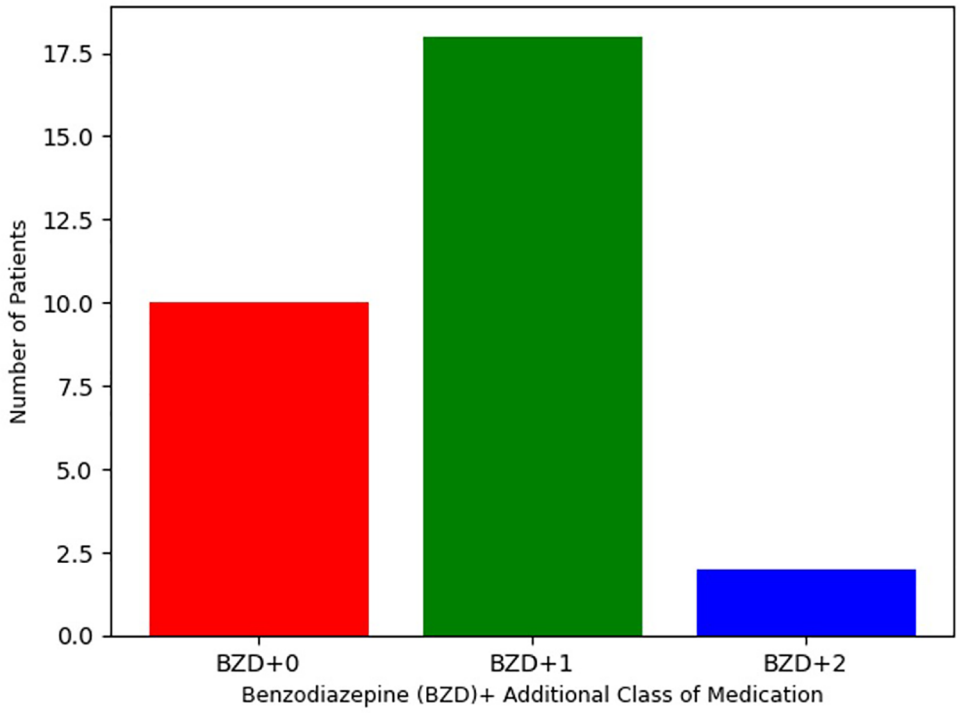

FIGURE 1
Number of medication classes in pediatric catatonia treatment.

treatments were also initiated based on therapeutic algorithms supported by the adult catatonia literature including (Table 3) NMDA receptor antagonists ($N = 13$, 42%), anti-epileptics ($N = 6$, 19%), and aripiprazole or clozapine ($N = 4$, 13%) (12). 19 (61%) received were prescribed one additional class of medication, and 2 (6.5%) received medications from three separate classes.

Significant aggression and hyperactivity consistent with treatment-refractory excited catatonia was present for 3 patients (10%). These individuals required admission to the pediatric intensive care unit, where they were treated with infusions of midazolam and dexmedetomidine. The clinical course of these patients is described in Supplementary Table S2, available online. Following treatment with intravenous infusions of midazolam and dexmedetomidine, all three patients demonstrated significant clinical improvement and were transitioned to oral benzodiazepines. In total, 9 patients (29%) were also treated with ECT. Among ECT recipients, 8 were treated with two alternative pharmacologic agents, and 1 was managed with one. A summary of ECT treatment can be found in Supplementary Table S3, available online.

3.5. Clinical outcome measures

As seen in Figure 2, statistically significant reductions in the BFCRS [$t = 11.2$, df = 30, std = 6.3, $p < 0.001$, 95% CI = (7.8, 15.1)], KCS [$t = 4.6$, df = 38, $p < 0.001$, 95% CI = (12.0, 31.0)], and KCE [$t = 7.8$, df = 30, std = 1.8, $p < 0.001$, 95% CI = (1.9, 3.2)] were observed. For CGI-I scores, we tested the ordinal GEE model intercepts, which represent the log odds that a subject falls into a scoring category greater than a given score. However, for the sake of interpretability, we transformed these log odds into the

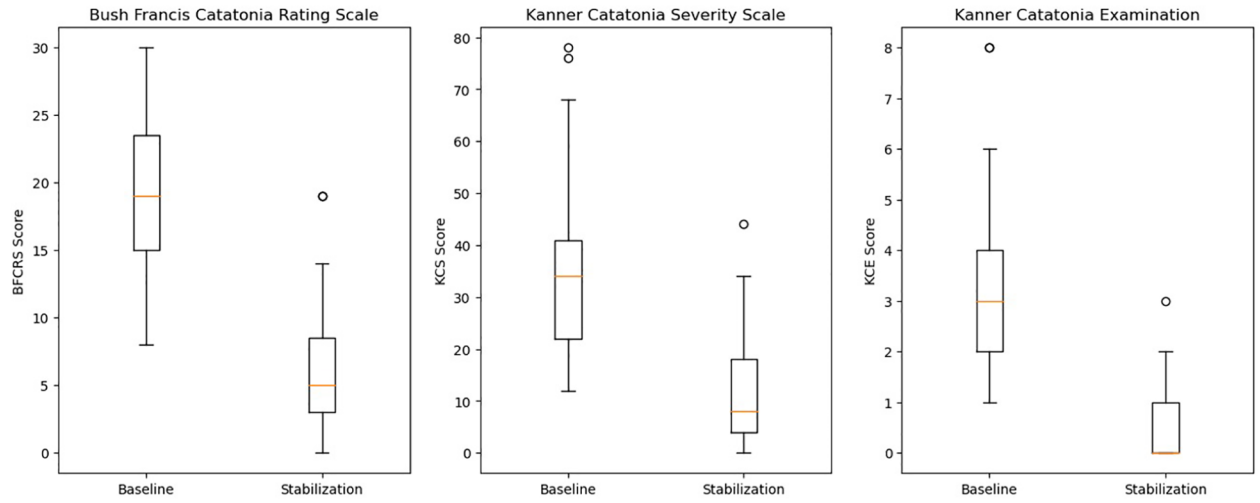

FIGURE 2
Comparison of catatonia outcome measures.

corresponding probabilities of occurrence. We found that both intercepts indicating a score greater than 4 or 3 were significant. The results showed that the estimated probability of observing a score better than no change (>4) is 0.976 [t.s. = 43.2, $p < 0.001$, 95% CI = (0.931,0.992)], indicating the average subject was expected to experience some improvement. Additionally, it was also very likely for a subject to experience "much improvement" with the estimated probability of receiving a CGI-I score greater than 3 of 0.863 [t.s. = 33.6, $p < 0.001$, 95% CI = (0.772,0.921)]. Moreover, we found high inter-rater reliability with a Gwet's AC_2 of 0.809 [95% CI = (0.726,0.893)]. Lastly, only 4 (13%) of patients were readmitted for psychiatric symptomology throughout the study period.

4. Discussion

This manuscript is a continuation of a brief report which discussed five pediatric patients with profound autism and hyperactive catatonia who received alternative psychopharmacologic interventions. In this brief report, we found that the use of benzodiazepines other than lorazepam, valproic acid, and NMDA receptor antagonists was safe and effective in treating catatonia in this population (29). Expanding on this previous work, in a retrospective cohort of 31 patients receiving alternative pharmacologic treatments for catatonia other than lorazepam, response (defined as an average retrospective CGI < 4 measured by all four raters) was observed in all 31 patients. Prior to initiating these treatments, 25 (81%) demonstrated a partial treatment response using lorazepam.

In our sample, all patients who experienced lorazepam partial response or breakthrough symptoms were stabilized on benzodiazepines. Among benzodiazepines, 27 patients (87%) had catatonia stabilized with clonazepam and 4 (13%) with diazepam. Benzodiazepines are positive allosteric modulators of the GABA-A receptor, but individual agents differ in pharmacokinetic properties, including half-life, receptor binding affinity, and lipid solubility (30). As a result, different benzodiazepines may be expected to have differing efficacies in the treatment of catatonia. This is supported by a crossover trial in adults comparing lorazepam and oxazepam, where the overall response was similar between the two agents, but with differing profiles of symptom relief and superiority of lorazepam on the second day of administration (31). Treatment with multiple agents was common as 21 (68%) of patients required treatment with a medication of a differing class for stabilization. These included NMDA receptor antagonists ($N = 13$, 42%), anti-epileptics ($N = 6$, 19%), and aripiprazole or clozapine ($N = 4$, 13%). 3 (10%) patients required midazolam and dexmedetomidine infusions for stabilization before transitioning to oral benzodiazepine. Our group reviewed two of these three PICU cases in our preliminary report addressing alternative psychopharmacologic interventions in pediatric catatonia (29).

One possible explanation for the high degree of lorazepam partial response ($N = 25$, 81%) in this study population is cortical hyperplasticity, associated with developmentally appropriate cortical growth in children (32), and is a leading neurobiological theory regarding the neurobiology of autism. Specifically, it is hypothesized that an excitatory:inhibitory (E:I) imbalance is present in autism, resulting in cortical hyperactivity is present in autism which may be indicative of GABAergic dysfunction and/or hyperplasticity due to impairment of long-term cortical plasticity mechanisms mediated by the NMDA receptor (33–35). Recent diagnostic work in transcranial magnetic stimulation of intellectually capable persons with autism (AIC) has reported enhanced cortical modulation, indicative of cortical hyperplasticity (35, 36). Furthermore, recent preliminary magnetoencephalographic research has reported greater E:I imbalance in biologically male patients with autism and co-morbid intellectual disability (AID) compared to AIC (37), suggests a direct correlation between the degree of E:I imbalance and cognitive impairment. These findings, along with the potential role of GABAergic signaling dysfunction in catatonia (5) and baseline cortical hyperplasticity observed in children (32), may explain why

longer-acting benzodiazepines at high dosages were required to stabilize catatonia. Specifically, a hyperplastic cortex may rapidly acclimate to a relatively short-acting benzodiazepine such as lorazepam leading to inadequately managed catatonic symptomology (4, 35). Indeed, previous case reports have identified lorazepam tolerance as a possible complication in the treatment of catatonia for individuals with co-morbid intellectual disabilities (38, 39).

Clinically, a statistically significant benefit was observed in the following domains: BFCRS, KCS, KCE, and retrospective CGI-I. Moreover, only 4 (13%) of patients were psychiatrically readmitted over the study period. In comparison, psychiatric readmission for children ranges from 10%–30% for any diagnosis and nearly 32% for children with a psychotic disorder (40).

Diagnostically, 84% of patients in our cohort had a neurodevelopmental disorder, with 65% having a previous diagnosis of autism spectrum disorder. These findings may occur due to the study site's inclusion of a neurodevelopmental psychiatry clinic specializing in catatonia and that the study population was identified in a large children's hospital. However, the data does provide additional evidence pointing to a connection between catatonia, neurodevelopmental disorders, and co-morbid genetic syndromes documented in other reports (4, 41). 19% were diagnosed with psychiatric conditions which contributed to the onset of catatonia. These findings are especially relevant as identification From a socio-economic perspective, 58% of patients were enrolled in Medicaid, highlighting that the majority of these patients and families likely experience financial as well as medical and psychiatric challenges.

Historical research has attempted to determine what aspect of autism is most likely to increase the risk of catatonia in autism. Specifically, intellectual disability as a risk factor for catatonia development has been discussed in recent meta-analytic autism work (4) and other reports (42, 43). Alternatively, an expert opinion of catatonia in autism by Shah and colleagues has speculated that social-emotional relatedness may be a critical factor in catatonia development (44). Dhossche and Fink have speculated that trauma and psychosocial stressors precipitate catatonia in children (45, 46). This is consistent with our findings as 9 (29%) of the patients in our study reported highly stressful events prior to the onset of catatonia. While this retrospective sample does not allow for drawing specific conclusions regarding risk factors for catatonia in autism, future research should continue to explore the role of intellectual capacities and communicative abilities in the clinical presentation of catatonia. Given the degree of morbidity associated with catatonia for autistic individuals across the lifespan (2, 47), identification of specific risk factors is critical.

In addition, our study supports previous research connecting severe psychiatric and medical comorbidities to pediatric catatonia (3). 3 (10%) of patients had a medical diagnosis contributing to catatonia, including seronegative auto-immune receptor encephalitis, anti-NMDA receptor encephalitis, and delirium. Notably, while catatonia has been reported in pediatric auto-immune encephalitis (48) and cases of delirium in adult patients (49), to our knowledge, our study includes the first report of catatonia occurring after the onset of delirium in a pediatric patient. Moreover, we found that the majority of catatonic patients were identified in the inpatient setting by the CAP-CL team. Given the interface of psychiatric and medical care in catatonia, CAP-CL providers have long considered diagnosis and treatment of catatonia within the scope of their practice (7). However, this very high identification rate by CAP-CL providers observed in our study further emphasizes the importance of education regarding pediatric catatonia in CAP-CL. Moreover, due to the high morbidity and mortality associated with pediatric catatonia, this represents a possible area of high-impact clinical intervention for CAP-CL providers (3, 5, 9).

We also found one patient who developed catatonia after using cannabis and two others who developed catatonia after initiating methylphenidate in the treatment of ADHD. While catatonia has been reported as a potential complication of cannabis use in adolescents (50, 51), to the authors' knowledge, this is the first report of catatonia days after initiating methylphenidate products to treat ADHD. The patients were biological males six and nine years of age, presenting to pediatric medicine and managed by the CAP-CL. The six-year-old patient carried diagnoses of autism and ADHD and received methylphenidate for three weeks before catatonia onset. The nine-year-old had a previous ADHD diagnosis and no other psychiatric comorbidities. This patient became catatonic within one day of methylphenidate initiation. These cases, the high rate of catatonia diagnoses in the pediatric medical hospital, and previous reports connecting cannabis use and catatonia highlight the need for CAP-CL psychiatrists to include robust systematic substance use screening in their regular clinical practice (7, 52).

In the clinical assessment of pediatric catatonia, the identification of neurodevelopmental disorders, autoimmune conditions, delirium, substance exposure, and psychiatric illness as possible causes of catatonia is critical. When present and identified, treating the underlying condition resulting in catatonia is a critical step to ensure recovery and remission of catatonia symptoms. However, specific causes of catatonia can be elusive and may not present until months or years after the acute onset of catatonia (53). In neurodevelopment disorders such as autism, the core symptoms of the disorder cannot be managed pharmacologically, limiting a clinician's ability to address the underlying cause (4). Such complications highlight the importance of a comprehensive medical workup in acute catatonia as identification and treatment of an underlying condition may significantly impact a patient's morbidity and long-term prognosis (10, 12).

Strengths of the study include a large sample size for a study of pediatric catatonia and broad inclusion criteria allowing for a description of treatment in children with a range of baseline diagnoses. As the study population is derived from a specialist pediatric hospital and NDD clinic, there are high rates of NDDs that may not be generalizable to the overall population of children with catatonia. Our study primarily focuses on the acute management of pediatric catatonia, without delving into the treatment of potentially causative underlying conditions. The authors recommend that future research explore this area by obtaining and analyzing longitudinal data once the acute phase of catatonia has resolved. Moreover, this study utilized the KCRS

and BFCRS for catatonia assessment (24). Neither of these scales have been specifically validated in the pediatric population, and the BFCRS is not designed for individuals with NDDs. Additionally, seven patients were most recently evaluated by telemedicine, and the accuracy of remote assessment of catatonia has not been studied. The retrospective nature of CGI-I scoring is an additional limitation in our study. To mitigate this, we blinded authors who provided CGI-I scores and reported the degree of inter-rater reliability. Another potential limitation is the possibility of inaccuracies in medical records, an issue inherent to our study design. ECT was also used in 9 cases, which likely improved overall clinical outcomes for these patients. Therefore, our ability to fully determine the efficacy of pharmacologic interventions in these cases is limited. There is also the potential for bias in our study, as the BFCRS and KCRS were used as part of clinical care and thus, were unblinded. Lastly, due to the limited verbal ability of 15 (48%) patients in our study, the full scope of side effects was difficult to determine.

Overall, there is a high risk of morbidity and mortality associated with pediatric catatonia (3, 5, 9), which necessitates prompt screening and treatment. Our manuscript provides data supporting the safe and effective use of alternative psychopharmacologic agents in treating pediatric catatonia. Future research should address possible risk factors of pediatric catatonia in NDD populations, work to validate the KCRS and determine if additional catatonia symptoms are specific to a given population, and determine if other psychopharmacologic agents may be of therapeutic benefit, ideally with controlled trials.

Presentations

Incomplete versions of this data were presented at the 69th American Academy of Child and Adolescent Psychiatry Annual Meeting, Toronto, Canada, October 17th – 22nd, 2022 and the International Association for Child and Adolescent Psychiatry and Allied Professions 2022 Annual Meeting, Dubai, United Arab Emirates, December 5th – 9th, 2022.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Vanderbilt University Medical Center Institutional Review Board. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contribution

JS: Conceptualization, Methodology, Investigation, Data Curation, Writing—Original Draft, Supervision. IB: Investigation, Data Curation, Investigation, Writing—Original Draft. TY: Conceptualization, Data Curation, Investigation, Writing—Review and Editing. CA: Conceptualization, Data Curation, Investigation, Writing—Review and Editing. TM: Data Curation, Methodology, Investigation, Writing—Review and Editing. SV: Data Curation, Methodology, Investigation, Supervision. LW: Conceptualization, Writing—Review and Editing, Supervision. JL: Conceptualization, Methodology, Writing—Original Draft, Supervision. All authors contributed to the article and approved the submitted version.

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Conflict of interest

JL receives equity from Revival Therapeutics.

The author LW declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frcha.2023.1208926/full#supplementary-material

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Key attributes of child psychiatry access programs

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The gap between the need for and the availability of pediatric mental health providers is well documented. One solution is regional/state Child Psychiatry Access Programs (CPAPs), which aid in the assessment and management of youth with behavioral health (BH) concerns by providing consultation to Pediatric Primary Care Clinicians. Our authorship team and the National Network of Child Psychiatry Access Programs (NNCPAP) board worked to describe operational definitions for CPAPs elements and related outcome monitoring processes and data systems. CPAP elements include regional child psychiatry availability by phone; real time phone availability; referral and resource assistance; and, expedited face-to-face psychiatric evaluation. Defining a child psychiatry consultation program as a CPAP and describing key attributes for CPAPs is an important step in facilitating implementation of the model and advancing research into its effectiveness.

KEYWORDS

access programs, behavioral health, primary care clinicians, program evaluation, consultation

Introduction

The nationwide gap between the need for pediatric mental health providers and their availability in the United States (US) is well documented: only 20% of youth with a mental health disorder receive care from a specialized Behavioral Health (BH) provider (1). While only one in three pediatricians report sufficient training to diagnose and treat children with behavioral disorders, pediatric primary care clinicians prescribe most psychiatric medications for children in outpatient settings (1). BH integration into primary care is a response important to the challenge of inadequate child BH workforce capacity (2). One approach to integrating behavioral health care into pediatric primary care is statewide Child Psychiatry Access Program model (CPAPs). CPAPs increase access to child mental health care by providing a system of regional children's BH consultation teams that help pediatric primary care clinicians and practices manage the BH of pediatric patients (4). The first CPAP was established in Massachusetts in 2004 to aid pediatric primary care clinicians in providing psychiatric treatment to youth through consultation and referral services (3). In regions with a statewide CPAP, children are significantly more likely to receive mental health services (5). The Health Resources and Services Administration (HRSA) funding for Pediatric Mental Health Care Access (PMHCA) in the US 2021 and 2022 (6) expanded pediatric BH integration and led to similar programs across and beyond the US. There are now 46 CPAPs under development and/or existing in 46 states, as well programs in the District of Columbia,

two tribal communities and four US territories, and internationally in British Columbia, Canada, and Australia. As a model, CPAPs are designed to assist primary care clinicians with managing children with mild to moderate psychiatric illness by providing real time phone consultation, referral and resource assistance and expedited face-to-face psychiatric evaluation.

A systematic review by Bettencourt and colleagues of methods used to evaluate CPAPs published in 2020, reviewed 29 publications evaluating 13 programs in 11 states, focusing primarily on program utilization and provider satisfaction, practices, and self-efficacy. With respect to outcomes for patients and families, the authors noted that the available publications analyzed access to treatment rather than behavioral health outcomes because the studies being conducted where largely descriptive rather than experimental (7). Nevertheless, key findings from these studies suggest that primary care clinicians adopt the model, are satisfied with direct consultation for diagnostic assistance and medication related questions, and that their ability to manage more complex cases increases with time (7). Additionally, most studies evaluated the consultation/evaluation and referral service rather than the education/training component, making it difficult to draw conclusions about the different elements of the model. Likewise, there has been limited focus on patient outcomes (7).

A major barrier to the study of these programs is the absence of a consensus description and set of criteria defining the CPAP model. The National Network of Child Psychiatry Access Programs (NNCPAP) is a nation-wide association established in 2011 to support existing and emerging CPAPs by creating of a data base and toolkit for new programs, and collaboration on evaluation and research (8). In this perspective article, we outline CPAP operational definitions that were developed based on the existing literature and expert consensus. Experts included members of the NNCAP board and leaders of CPAP programs. The definitions were developed based on an initial consensus then refined based on interactive feedback from these experts.

Definition and core elements

Definition

Child Psychiatry Access Programs (CPAPs) are a model of care wherein pediatric primary care clinicians receive training and support in treating their patients with regard to mental health and substance use disorders via in-person, phone, or online case-based consultation from off-site mental health professionals.

Primary goal of CPAPs

Increase access to pediatric mental health and substance use services by providing consultation and training to pediatric primary care clinicians to increase their comfort and skills in managing mild to moderate mental health and substance use disorders.

CPAP elements

1. Provision of on-demand telephonic consultation by child and adolescent psychiatrists and optionally other licensed children's mental health professionals to pediatric primary care clinicians and integrated behavioral health clinicians in the pediatric primary care practices in/for a defined region/population regarding diagnosis and management of mental health and substance use disorders.
2. Real time response (calls returned within 30 min when possible, or at least within same workday). Real time response can also be available through asynchronous communication (email, secure messaging).
3. Provision of referrals and resource navigation.
4. Availability of expedited in-person or virtual psychiatric evaluation when indicated.
5. Formal continuing education sessions for pediatric primary care clinicians and assistance with practice transformation to integrate behavior health. Educational tools may include practice guidelines, website, webinars, and newsletters.

CPAP outcome and performance monitoring

CPAPs use a data system to monitor program performance and outcomes. Usage is monitored with an encounter database which captures demographic information about the patient served, the provider requesting help, the type of presenting mental health problem, the nature of the presenting need or question, and the type of service provided to the pediatric primary care clinicians and/or patient. In addition, a web-based database includes number of practices and/or pediatric primary care clinicians enrolled and annual utilization; pediatric primary care clinicians' satisfaction; and pediatric primary care clinicians' comfort and confidence with managing mental health concerns (change from baseline). Additional elements may include measures of provider practice change, including the use of screening, practice guidelines, measurement-based practice, and total practice BH outcomes; patient outcomes; and family member satisfaction with services. Performance measures include the degree to which the program reaches the entire geographic region population (percent of practices enrolled and utilizing).

Discussion and next steps

CPAPs are a model for providing pediatric BH care created in response to unmet BH needs among children and adolescents, resource and workforce gaps, and deficits in graduate medical education training for pediatric primary care clinicians. The CPAP has grown in recent years and continues to grow. While there are currently CPAP versions in multiple states as well as international programs, there is limited multistate or nationwide research and no formal operational definitions of a CPAP. Taken together, this suggests that policy makers and funders are moving

forward with supporting the CPAP model as a solution to pediatric behavioral health care access, without the benefit of clear data on the effectiveness of the model.

Better understanding of the different components of each program, and the establishment of consensus criteria for the model is an important first step in the development of measures that could facilitate outcome evaluation on a larger scale (9). In this paper, we present operational definitions of program elements, outcome measurement processes and database systems as a first step toward to facilitating such evaluation.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Author contributions

All authors contributed to the writing of this article. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The author YD declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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Sleep problems and parental stress among caregivers of children and adolescents enrolled in a digital mental health intervention

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Introduction: Caregivers of children with mental health problems such as anxiety, depression, and attention-deficit/hyperactivity disorder often experience heightened sleep problems, largely due to their children's disrupted sleep, and increased parental stress. Evidence suggests that mental and behavioral health care for children and adolescents has the potential to positively affect their caregivers; however, this has not been investigated in the context of pediatric digital mental health interventions (DMHIs). Therefore, the current study used caregivers' self-report measures to determine whether caregivers whose children are involved in a DMHI exhibit improvements in sleep problems and parental stress after initiation of their children's care.
Methods: Caregivers with a child or adolescent participating in behavioral coaching and/or therapy with Bend Health Inc., a pediatric DMHI that involves both the child and caregiver in care (e.g., coaching and therapy), were included in the study ($n = 662$). Caregiver insomnia severity and parental stress were reported approximately every 30 days using the Insomnia Severity Index (ISI) and Parental Stress Scale (PSS). Changes in symptoms were assessed by comparing caregivers' symptom scores from baseline to first assessment after starting care.
Results: Among caregivers with elevated insomnia severity ($n = 88$) and parental stress ($n = 119$) at baseline, 77% showed improvements in sleep and 73% showed improvements in parental stress after the initiation of their child's care, with significant decreases in score from baseline to post-care (ISI: $t\ 72 = -4.83$, $P < .001$, $d = 0.61$; PSS: $Z = -4.98$, $P < .001$, $d = 0.59$).
Discussion: While extant research suggests ongoing links between child behavioral problems, parent sleep, and parent well-being, this is the first study to demonstrate improvements in caregiver sleep and stress when a child's mental health symptoms are addressed with behavioral care. Our findings offer promising preliminary evidence that caregivers experience significant secondary benefits to their sleep and parental stress when their children participate in a pediatric DMHI. Further research is warranted to investigate additional moderating and mediating factors, such as caregiver demographics and magnitude of child mental health improvement.

KEYWORDS

telehealth, online coaching, online therapy, insomnia symptoms, pediatrics, family-based care

Abbreviations
DMHI, digital mental health intervention; MBC, measurement based care; PCP, primary care physician; BCM, behavioral care manager; ISI, insomnia severity index; PSS, parental stress scale.

1. Introduction

There is mounting evidence that the relationship between the well-being of a child and their caregiver is complex and bi-directional, such that a child's well-being may be a salient predictor of their caregiver's well-being (1–8). Caregivers of children with mental health problems tend to also have impairments in their health and well-being (3, 9, 10). In fact, caring for a child with a mental health or behavioral problem has been identified as a risk factor for sleep problems and parental stress [i.e., stress related to the functioning of a caregiver (1, 11–13)].

Sleep is foundational to mental and behavioral health, supporting cognitive functioning, emotional regulation, development, and resilience in both children and adults (14–19). Studies have demonstrated that impairments in child sleep may predict caregiver sleep problems (5, 9, 20, 21). For example, caregivers lose sleep when their children awaken frequently at night, often because they need to help their child return to sleep or their sleep environment is disturbed by child-elicited factors such as noise and light (8). Sleep problems may be more prevalent for caregivers of children and adolescents with mental health problems, as these children tend to have more difficulty falling asleep, staying asleep, and waking up in the morning (22–24).

Research suggests that a child's mental health problems are also associated with parental stress. Children and adolescents with internalizing (e.g., anxiety and depression) and externalizing (e.g., conduct disorder and oppositional defiance) problems are more likely to have parents with elevated stress (1, 11, 13). Several studies have found that caring for a child with severe externalizing symptoms is particularly burdensome for caregivers and confers risk for increased parental stress (5, 6, 11, 13, 20, 25). Caregivers of children with mental health problems may experience increased strain on their time and finances, as well as diminished feelings of happiness and fulfillment in their parenting roles, both of which contribute to increased parental stress.

Interventions to address child sleep problems may improve caregiver sleep (26–28), even when caregiver sleep is not directly targeted by the treatment. Behavioral care (e.g., coaching and therapy) is a common treatment for mental health problems in children and adolescents, and there is evidence that the positive effects of in-person therapy for children with behavioral problems may also be associated with reductions in parental stress (29). Caregivers are often crucial to the initiation of their children's help-seeking and engagement in mental health care, and they often show strong feelings of relief as a result of their children's initiation in care (30, 31). Together, these studies suggest that interventions targeted to children and adolescents may confer secondary benefits to their caregivers.

Although traditional modalities of mental health care, such as in-person therapy, offer clear therapeutic benefits, many young people with mental health problems are not receiving the care they need due to provider shortages, geographic limitations, and associated stigma. In response to this lack of accessibility, digital mental health interventions (DMHIs) have grown more popular as a comparable modality for mental health care. Although the effectiveness of certain DMHI modalities has yet to be established (33), several meta-analyses have demonstrated that DMHIs, particularly those using computerized cognitive behavioral therapy and those with an in-person element, are a promising avenue to address anxiety and depression in children and adolescents (31–33). However, no studies to date have assessed whether a child's participation in care with a DMHI is also associated with positive outcomes for their caregiver. The purpose of this study is to assess whether caregivers with elevated sleep problems and parental stress show symptom improvements between their child's enrollment and first care appointment with a collaborative care digital mental health provider. We hypothesized that caregiver sleep problems and parental stress would decrease from baseline to the first assessment after beginning care and would continue to decrease throughout care.

2. Materials and methods

2.1. Design and participants

Caregivers (e.g., parents) of children (ages 2–12 years) and adolescents (ages 13–17 years) were eligible to be in the study if they: (1) began care with Bend Health Inc., a collaborative care DMHI, between January 1st 2023 and July 1st 2023, (2) had at least one coaching session with Bend Health Inc., and (3) completed caregiver assessments before and after the initiation of care. As such, $N = 662$ were eligible for inclusion in this study. Study procedures were approved by an independent institutional review board, Biomedical Research Alliance of New York (BRANY IRB; study identification number 23-12-034-1374).

2.2. Treatment

Bend Health, Inc. is a collaborative care DMHI that provides behavioral care for children and adolescents ages 2–17 years, an age range which encompasses peak ages of onset for most major mental illnesses (32). Bend Health also provides care to youths' families (e.g., parents), as described in detail previously (33, 34). Members can be referred to Bend Health Inc. via their PCP, and they can also enroll through insurance, employer benefits, or direct-to-consumer. Once enrolled in care, members and their caregivers are assigned a Behavioral Care Manager (BCM), who meets with the member and their caregiver in an initial synchronous evaluation (start of care). After the initial evaluation, the BCM continues to monitor and oversee the member's care with a Bend Health Inc. care team. All members are assigned a coach, and some are also assigned a therapist based on a member's symptom severity, mental health comorbidities, insurance coverage, and services desired. Members

with more severe symptoms may have sessions with a therapist and a coach, whereas members with less severe symptoms may only have sessions with a coach. Members that require evaluation for psychiatric medication may also see a psychiatric provider (psychiatrist or nurse practitioner). Members may attend up to three synchronous (video and voice) sessions a month with a coach or therapist, and up to five synchronous sessions a month with any Bend Health Inc. practitioner (including psychiatric providers). Online asynchronous messaging is available for caregivers to communicate with their child's care team outside of synchronous sessions. Approximately once a month, caregivers and their child/adolescent are prompted to complete screeners and validated assessments of caregiver and child mental health outcomes (described in detail below).

In synchronous coaching and/or therapy sessions, Bend Health Inc. practitioners guide members and their caregiver/s through structured care plans that are designed to target specific symptoms and mental health problems (e.g., problematic behaviors and anxiety). The care programs are also delivered through an online learning resource center (including informational resources and guided activities), where members and their caregiver/s may further develop their skills to manage and improve mental health symptoms between synchronous sessions. Therapy sessions may also serve to provide a clinical foundation to the treatment of more serious or complex mental health challenges in children and adolescents. Bend Health Inc. therapists are licensed (LMFT, LPC, LCSW, or LMHC), coaches hold an ICF Coaching certification, NBC-HW, or master's degree in psychology, and BCMs hold a bachelor's degree in psychology or coaching certification. Moreover, all coaches and therapists are trained in modalities of cognitive behavioral therapy, behavioral activation, parent management training, mindfulness-based cognitive therapy, motivational interviewing, and mindfulness-based stress reduction. Bend Health Inc. care plans and coaching/therapy sessions are intended to be age-appropriate, and care programs for younger children place more of an emphasis on caregiver participation. Conversely, coaching/therapy sessions with adolescent members may be less involved for caregivers. Caregivers are required to attend all synchronous sessions with their child aged 2–12, and they must be in the same general location (e.g., in the same house) as their adolescent child aged 13–17. All members are free to withdraw from participation in Bend Health Inc. services and research studies at any time.

2.3. Measures

All measures are administered online using caregivers' self-report. When enrolling in care with Bend Health Inc., caregivers provide demographic information, including date of birth, sex at birth (male, female, or other) and gender (male, female, transgender, non-binary, or other), and race/ethnicity for the participating member (child or adolescent). From January 2023 to May 25, 2023, the race/ethnicity options were: "American Indian or Alaska Native", "Asian", "Black or African American", "Hispanic or Latino", "Native Hawaiian or other Pacific Islander", "White", and "Other". Starting May 26, 2023, these options were updated to better align the measure with U.S. census standards by including the following categories: "White", "Black or African American", "American Indian or Alaska Native", "Chinese", "Vietnamese", "Native Hawaiian", "Filipino", "Korean", "Japanese", "Chamorro", "Other Asian", "Other Pacific Islander", "Some other race or multi-racial", "Mexican, Mexican Am., Chicano", "Puerto Rican", "Cuban", "Another Hispanic, Latino, or Spanish origin". Before their first synchronous session with a BCM, caregivers complete assessments to assess their own sleep problems and parental stress (baseline). Caregiver assessments are repeated approximately every 30 days after enrollment to continually monitor symptom severity throughout the duration of care with Bend Health Inc.

To flag caregivers with sleep problems, caregivers are asked to respond to the following screener question: "During the past two (2) weeks, how much (or how often) have you had problems sleeping–that is, trouble falling asleep, staying asleep, or waking up too early?" Responses are on a 5-item Likert scale (0 = Not at all, 4 = Nearly every day). If the response to this screener is 2 or greater (several days or more frequently), caregivers are prompted to complete the insomnia severity index [ISI; (35, 36)]. If their response to this screener is less than 2, they do not complete the ISI. The ISI is a validated assessment consisting of 7 items, in which three items query the severity of a specific sleep problem (e.g., difficulty falling asleep) and four items query satisfaction or perception of sleep difficulties (34). In response to each item, the caregiver selects the best-fit response on a 5-item Likert scale (e.g., 0 = None, 5 = Very severe) to indicate their sleep problems over the last two weeks.

For parental stress, caregivers respond to the following screener questions, taken from the Parental Stress Scale (PSS; 37): "The major source of stress in my life is my child" and "Having a child leaves little time and flexibility in my life." Responses to the PSS items are on a 5-item Likert scale (1 = Strongly disagree, 5 = Strongly agree). If the response to either screener question is 3 (undecided) or greater, the caregiver is prompted to complete the other 16 items on the Parental Stress Scale. The PSS includes 18 items which are presented as statements of subjective feelings and perceptions of a caregiver's feelings about their relationship with their child and their role as a parent. Most items are framed in terms of negative experience [e.g., "The major source of stress in my life is my child(ren)"] and some are framed in terms of positive experience (e.g., "I am happy in my role as a parent"). Items 1, 2, 5, 6, 7, 8, 17, and 18 are frames as a positive experience.

2.4. Statistical analysis

Months in care was calculated as the number of months (30 days) since the start of care (first synchronous session). The number of care sessions per month was calculated as the total number of coaching and therapy sessions attended divided by the number of months in care. One month was used as the divisor for care sessions per month for members in care less

than one month, to accurately represent care session frequency. Given that the race/ethnicity question was change part-way through the study timeframe, the following categories were used to report member's race/ethnicity information: White (includes response: "White"), Black or African American (includes response: "Black/African American"), Hispanic or Latino (includes responses: "Hispanic/Latino", "Puerto Rican", "Other Hispanic/Latino", and "Mexican, Mexican American, or Chicano"), Asian (includes responses: "Asian", "Other Asian", "Chinese", "Korean", and "Filipino"), and Other or multi-racial (includes responses: "Other" and multi-select responses).

Caregiver ISI scores were calculated by aggregating the scores for all seven items, for an ISI score range of 0–28. An ISI score of 0–7 indicates no clinically significant insomnia, a score of 8–14 indicates subthreshold insomnia, a score of 15–21 indicates moderate severity clinical insomnia and a score of 22 or greater indicates severe clinical insomnia. To calculate caregiver PSS scores, the individual scores from the responses to the positively framed items (e.g., "I am happy in my role as a parent") were reversed (e.g., a response of "1 = Strongly disagree" was converted to a score of 5). Then, all item scores were aggregated for a PSS score range of 18–90. Using the same scoring categories as described by others (36, 37), A PSS score of 18–41 indicates mild severity parental stress, a PSS score of 42–65 indicates moderate severity parental stress, and a score greater than 65 indicates severe parental stress.

2.4.1. Member characteristics

Caregivers with an ISI score indicating clinically significant insomnia severity (moderately severe or greater; score > 14) at baseline were included in the "caregivers with elevated sleep problems" group. Given that there is no established criteria for clinically significant parental stress, caregivers with a PSS score indicating moderate or severe parental stress (score > 41) were included in the "caregivers with elevated parental stress" group. Only caregivers with an assessment before the start of care and after the start of care were included in all statistical analyses. The following between-groups tests were performed to compare member characteristics between each elevated symptom group and the non-elevated symptom group: Wilcoxon signed-rank tests for member age at baseline, duration in care, and session frequency between the non-elevated symptom group and each elevated symptom group, and Chi-squared tests for distributions of sex (female vs. non-female), gender conformity, race/ethnicity (White vs. non-white), mental health condition diagnosis (for no diagnosis, anxiety disorders, ADHD, and depressive disorders), and care type (coaching vs. coaching and therapy).

2.4.2. Change in symptom severity

Only data from caregivers with elevated sleep problems or caregivers with elevated parental stress were included in analyses of symptom change. To assess whether caregiver sleep problems and parental stress changed from before to after the initiation of care with the DMHI, ISI and PSS scores from the assessment before the start of care were compared to scores from the first assessment after the start of care (post care) using *t*-tests or Wilcox signed-rank tests, as appropriate. Effect sizes for these statistical tests were reported using Cohen's *d* (38). To determine whether duration in care had a significant effect on sleep problems and parental stress, ISI and PSS scores over all months in care were assessed using linear mixed-effects models with a fixed effect of months in care and a random effect of subject on the intercept. Potential predictor variables were added to this main model individually in alternative models, and then each alternative model was tested against the main model using the likelihood-ratio test (LRT). Where a predictor improved model fit (significant LRT), it was retained in the final model. The following predictor variables were assessed: member age (at caregiver assessment), member sex (female vs. non-female), member race/ethnicity (white vs. non-white), and member care type (coaching vs. coaching & therapy). Results from the *F*-tests for each main effect are reported to assess for changes in symptom severity over months in care, and also to assess associations between retained predictor variables and symptom severity. Missing data was estimated using maximum likelihood (ML) estimation in the linear mixed-effects models.

All reported *P*-values were corrected for using the Benjamini-Hochberg method (39). The demographic and care statistics (between-groups comparisons) for each group of elevated symptoms (elevated sleep problems and elevated parental stress) were corrected as a group. Change statistics (pre-care vs. post-care) and all *P*-values from the linear mixed-effects model *F*-tests for each symptom type (sleep problems and parental stress) were corrected as a group. Percentages, mean and standard deviation (M ± SD), and median and interquartile range (IQR) were used to describe the data throughout, and the alpha level was set to 0.05 for all analyses.

3. Results

3.1. Baseline symptom severity

At baseline, over half of the caregivers screened out of completing the ISI assessment (52.6%; $n = 348$), 10.6% had no clinically significant insomnia ($n = 70$), 23.6% had sub-threshold (mild) insomnia ($n = 156$), and 13.3% had clinically significant insomnia ($n = 88$). Of those with clinically significant (elevated) insomnia, 75.0% had moderate severity insomnia ($n = 66$) and 25.0% had severe insomnia ($n = 22$). All caregivers that completed the ISI had a score of 11.97 ± 5.19 at baseline ($n = 314$). In terms of parental stress at baseline, 36.9% of caregivers screened out of completing the PSS assessment ($n = 244$), 45.2% had mild parental stress ($n = 299$), and 18.0% had moderate parental stress ($n = 119$). No caregivers had severe parental stress. Caregivers that completed the PSS had scores of 37.02 ± 8.16 at baseline ($n = 498$). Ultimately, 57 caregivers were only in the elevated sleep problems group, 88 were only in the elevated parental stress group, and 31 were in both groups. All other caregivers ($n = 486$) were in the non-elevated symptoms group.

3.2. Member characteristics

Comprehensive demographic characteristics and results from between-groups statistical tests are reported in Table 1. The elevated sleep problems group (13.3%; $n = 88$) was largely similar to caregivers with non-elevated symptoms (non-elevated sleep problems and parental stress; $n = 486$) in terms of their child or adolescent member's age, gender conformity, and ethnicity (all $P > .05$). Caregivers with sleep problems had an approximately equal split of female versus non-female members (Female: 47.7%; $n = 42$). Most caregivers with elevated sleep problems reported their member's race/ethnicity as "White" or other/multi-racial (together 82.9%; $n = 73$). In terms of mental health conditions of children/adolescents of caregivers with elevated sleep problems, 27.3% ($n = 24$) had an anxiety disorder, 28.4% ($n = 25$) had a subtype of ADHD, and 4.5% ($n = 4$) had a depressive disorder. Compared to the non-elevated symptoms group, the rates of diagnosis were similar for children of caregivers in the elevated sleep problems group.

Compared to caregivers with non-elevated symptoms, the elevated parental stress group (18.0%; $n = 119$) tended to have younger children ($Z = -2.55$, $P = .061$) and their child/adolescent members were less predominantly female ($\chi^2 = 5.72$, $P = .062$), though the between-groups statistical tests approached significance. These two groups did not differ in terms of gender conformity and race/ethnicity. Caregivers with elevated parental stress more predominantly had children vs. adolescents (73.9%; $n = 88$), less than half had female children (41.1%; $n = 48$), and most reported their member's race/ethnicity as "White" or other/multi-racial (together 84.9%; $n = 101$). In terms of mental health conditions of children/adolescents of caregivers with elevated parental stress, 25.2% ($n = 27$) had an anxiety disorder, 21.0% ($n = 25$) had a subtype of ADHD, and 4.2% ($n = 5$) had a depressive disorder. Compared to caregivers with non-elevated symptoms, caregivers with elevated parental stress were less likely to have children with an anxiety disorder diagnosis ($\chi^2 = 9.89$, $P = .022$). Otherwise these two groups did not differ in terms of depressive disorder, ADHD, or no diagnosis.

For all caregivers, most of their children/adolescents were in coaching only vs. coaching and therapy: 80.9% for caregivers with non-elevated symptoms ($n = 393$), 75.0% for caregivers with elevated sleep problems ($n = 66$), and 75.6% for caregivers with

TABLE 1 Member characteristics and results from statistical comparisons between each group of caregivers with elevated symptoms and caregivers with non-elevated symptoms.

Member characteristics	Non-elevated symptoms group ($n = 486$)	Elevated sleep problems group (13.3%; $n = 88$)			Elevated parental stress group (18.0%; $n = 119$)		
	Value	Value	Statistic	*P*-value	Value	Statistic	*P*-value
Age in years	10.9 ± 3.7	10.0 ± 3.5	−2.20[a]	.23	10.1 ± 3.4	−2.55[a]	*0.061*
Sex							
Female	53.1% ($n = 258$)	47.7% ($n = 42$)	0.66[b]	.72	40.3% ($n = 48$)	5.72[b]	*0.062*
Male	45.9% ($n = 223$)	51.1% ($n = 45$)			58.8% ($n = 70$)		
Other or non-binary	1.0% ($n = 5$)	1.1%% ($n = 1$)			0.8% ($n = 1$)		
Gender conformity							
Conforming	93.2% ($n = 453$)	94.3% ($n = 83$)	0.02[b]	.88	94.1% ($n = 112$)	0.02[b]	0.95
Non-conforming	6.8% ($n = 33$)	5.7% ($n = 5$)			5.9% ($n = 7$)		
Race/ethnicity							
White	40.9% ($n = 199$)	38.6% ($n = 34$)	0.08[b]	.88	42.9% ($n = 51$)	0.08[b]	0.95
Other or multi-racial	45.5% ($n = 221$)	44.3% ($n = 39$)			42.0% ($n = 50$)		
Black/African American	5.8% ($n = 28$)	6.8% ($n = 6$)			5.0% ($n = 6$)		
Hispanic/Latino	4.9% ($n = 24$)	2.3% ($n = 2$)			2.5% ($n = 3$)		
Asian	2.9% ($n = 14$)	8.0% ($n = 7$)			7.6% ($n = 9$)		
Mental health condition							
None	17.9% ($n = 87$)	23.9% ($n = 21$)	1.37[b]	.58	22.7% ($n = 27$)	1.14[b]	0.54
Anxiety disorder	41.4% ($n = 201$)	27.3% ($n = 24$)	5.63[b]	**.58**	25.2% ($n = 30$)	9.89[b]	**0.022**
ADHD	18.3% ($n = 89$)	28.4% ($n = 25$)	4.16[b]	**.23**	21.0% ($n = 25$)	0.30[b]	0.81
Depressive disorder	7.4% ($n = 36$)	4.5% ($n = 4$)	0.55[b]	.72	4.2% ($n = 5$)	1.09[b]	0.53
Care type							
Coaching only	80.9% ($n = 393$)	75.0% ($n = 66$)	1.25[b]	.58	75.6% ($n = 90$)	1.32[b]	0.54
Coaching and therapy	19.1% ($n = 93$)	25.0% ($n = 22$)			24.4% ($n = 29$)		
Care statistics							
Months in care	2.3 ± 1.2	2.4 ± 1.3	−0.31[a]	.88	2.4 ± 1.2	−0.77[a]	0.70
Care sessions per month	1.6 ± 0.8	1.6 ± 0.9	−0.26[a]	.88	1.6 ± 0.7	−0.06[a]	0.95

The between-groups comparison for sex was performed using the categories female and non-female. The between-groups comparison for race/ethnicity was performed using the categories white and non-white. *P* values have been corrected for multiple comparisons using the Benjamini-Hochberg method. Statistically significant values are bolded ($P < .05$), and statistical trends are italicized ($P < .10$).

[a]Z statistic.

[b]χ^2 statistic.

elevated parental stress ($n = 90$). Children and adolescents of caregivers with non-elevated symptoms were in care for 2.32 ± 1.17 months (range: 0.20–5.43 months) and members had 1.58 ± 0.78 care sessions (coaching and therapy) per month. This duration in care did not differ between caregivers with non-elevated symptoms and caregivers with elevated sleep problems (2.36 ± 1.27 months), as well as caregivers with elevated parental stress (2.40 ± 1.24 months). The number of care sessions per month also did not differ across groups (Elevated sleep problems: 1.57 ± 0.92; Elevated parental stress: 1.56 ± 0.74). Caregivers completed between two and six assessments total during their child's care with the DMHI; Table 2. While in care with the DMHI, caregivers with elevated sleep problems completed the sleep assessment every 1.27 ± 0.38 months and caregivers with elevated parental stress completed the parental stress assessment every 1.25 ± 0.28 months.

3.3. Change in symptom severity

3.3.1. Sleep problems

Caregivers with elevated sleep problems had an ISI score of 18.75 ± 3.11 at baseline. On the first assessment after the start of care, 18.2% of caregivers with elevated sleep problems screened out of completing the ISI ($n = 16$), 38.6% had subthreshold insomnia symptoms (mild; $n = 34$), 29.5% had moderately severe insomnia symptoms (n = 26), and 13.6% had severe insomnia symptoms (n = 12). For caregivers with elevated sleep problems, 77.3% exhibited a decrease in insomnia severity from before to after the start of care (n = 68), as indicated by screening out of the first assessment after care start or by a decrease in ISI score from baseline. For those that completed the ISI on the first assessment after the start of care ($n = 72$), their ISI scores decreased from 18.81 ± 3.11 at baseline to 16.29 ± 4.96 after the start of care ($d = 0.61$), for a change score of −2.59 ± 4.58 points from baseline ($t\ 72 = -4.83$, $P < .001$; CI: −3.66, −1.52); see Figure 1.

The addition of the following child/adolescent characteristics as predictors did not improve the fit of the sleep model: age ($\chi^2 = 2.29$, $P = .13$), sex (female or non-female: $\chi^2 = 1.46$, $P = .23$), race/ethnicity (white or non-white: $\chi^2 = 2.37$, $P = .12$), and care type (coaching or coaching and therapy: $\chi^2 = 1.79$, $P = .18$). Thus, the final model included a fixed effect of months in care and a random effect of member ID on the intercept. Ultimately, caregiver ISI scores decreased significantly by months in care ($F1,131 = 26.02$, $P < .001$), such that each additional month in care was associated with a 0.95 point decrease in ISI score (Figure 2).

TABLE 2 Number of assessments completed by caregivers with elevated sleep problems and caregivers with elevated parental stress.

Number of assessments completed	Elevated sleep problems group ($n = 88$)	Elevated parental stress group ($n = 119$)
2	46.6% ($n = 41$)	46.2% ($n = 55$)
3	31.8% ($n = 8$)	25.2% ($n = 30$)
4	13.6% ($n = 12$)	21.8% ($n = 26$)
5	7.9% ($n = 7$)	6.7% ($n = 8$)

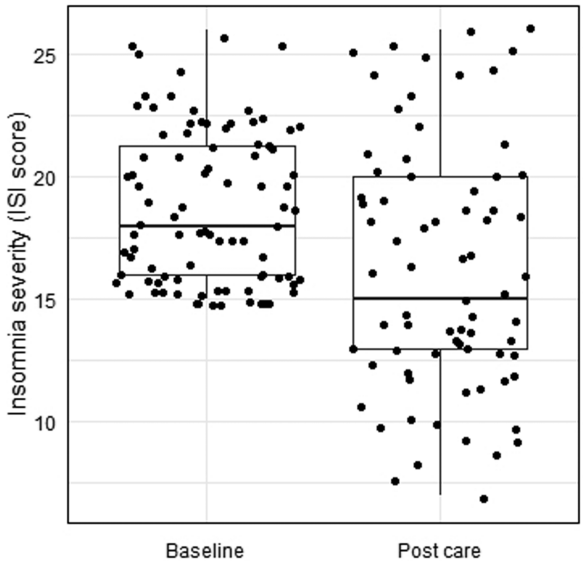

FIGURE 1
Caregiver insomnia symptom severity before and after the start of care with the DMHI.

3.3.2. Parental stress

Caregivers with elevated parental stress had a PSS score of 46.74 ± 4.87 at baseline. On the first assessment after the start of care, 20.2% of caregivers previously indicated as having elevated

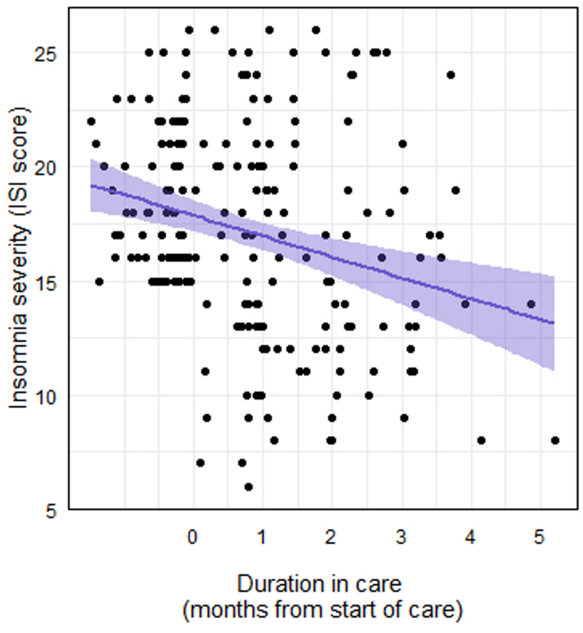

FIGURE 2
Caregiver ISI score over the course of their child's care with the DMHI.

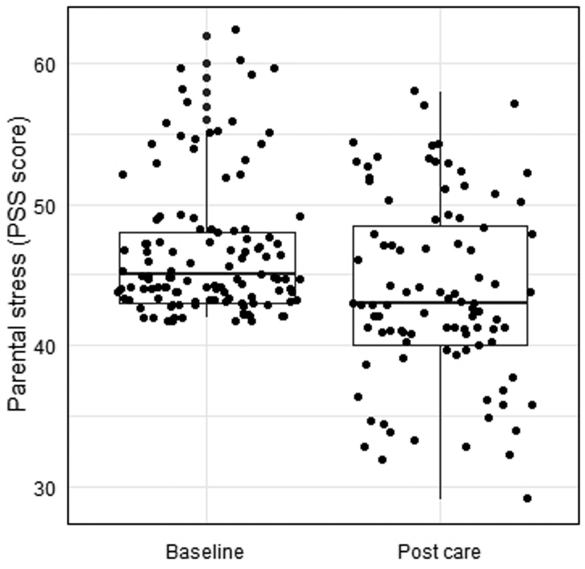

FIGURE 3
Caregiver parental stress before and after the start of care with the DMHI.

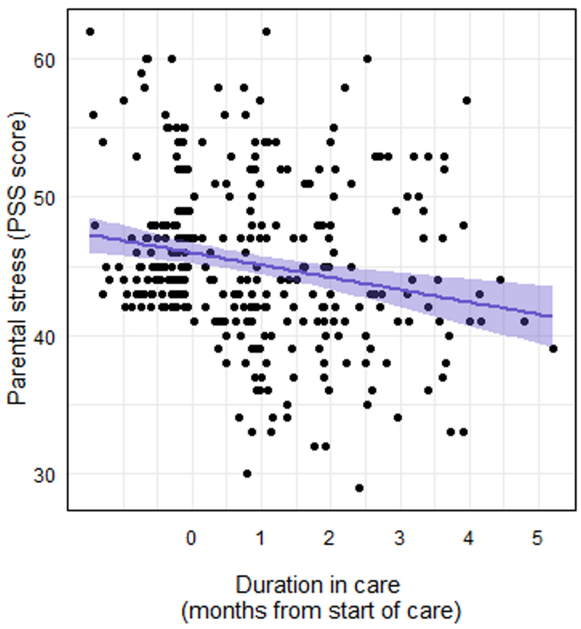

FIGURE 4
Caregiver PSS score over the course of their child's care with the DMHI.

parental stress screened out of completing the PSS ($n = 24$), 31.9% had mild parental stress ($n = 38$), and 47.9% had moderate parental stress ($n = 57$). For caregivers with elevated parental stress, 73.1% exhibited a decrease in parental stress from before to after the start of care ($n = 87$), as indicated by screening out of the first assessment after care start or by a decrease in PSS score from baseline. For those that completed the PSS on the first assessment after the start of care ($n = 95$), their PSS scores decreased from 47.24 ± 5.17 at baseline to 43.77 ± 6.49 after the start of care ($d = 0.59$; CI: $-Inf$, -2.50), for a median change score of -3 points (IQR = 7.25; $Z = -4.98$, $P < .001$); see Figure 3.

The addition of the following child/adolescent characteristics as predictors improved the fit of the stress model: sex (female or non-female; $\chi^2 = 4.99$, $P = .025$) and care type (coaching or coaching and therapy; $\chi^2 = 9.03$, $P = .003$). The addition of the following child/adolescent characteristics as predictors did not improve the fit of the stress model: age ($\chi^2 = 2.08$, $P = .15$) and race/ethnicity (white or non-white: $\chi^2 = 2.30$, $P = .069$). Thus, the final model included fixed effects of months in care, sex, and care type, and a random effect of member ID on the intercept. Caregiver PSS scores decreased significantly by months in care ($F1,188 = 35.17$, $P < .001$), such that each additional month in care was associated with a 1.14 point decrease in PSS score (Figure 4). The main effect of female sex approached statistical significance ($F1,116 = 3.53$, $P = .063$), as caregivers of females tended to have higher PSS scores than caregivers of non-females. The main effect of care type was statistically significant ($F1,116 = 6.86$, $P = .013$), such that caregivers of children in coaching only tended to have lower PSS scores than caregivers of children in coaching and therapy.

4. Discussion

4.1. Principal results

The purpose of this study was to assess caregivers' self-reported sleep quality and parental stress before the start of care and up to 6 months after the start of care for their child or adolescent with a collaborative care digital mental health provider, Bend Health, Inc. We found that sleep problems and parental stress of caregivers decreased after their child or adolescent initiated care in a collaborative care DMHI. Improvements in caregivers' sleep problems and parental stress were linked to the duration of their children's participation with the DMHI, with each additional month in care associated with larger improvements. Although nascent research has demonstrated benefits to caregivers of youth participating in behavioral care (29, 40, 41), this is the first study to suggest that these benefits extend to digitally-delivered behavioral care.

Both sleep problems and parental stress decreased significantly between the child's initiation of care and first follow-up assessment among parents whose children were enrolled in Bend Health. Despite the fact that current Bend Health care programs are directed toward children and not parents, our findings suggest that initiation and duration of mental health care for children is positively linked to improvements in crucial aspects of caregiver well-being. These findings are bolstered by previous studies, which have found that parent sleep problems decrease as a result of behavioral care that mitigates child sleep problems (26, 27). Findings from several studies among parents of children with oppositional symptoms also suggest that parental stress decreases as a result of children's participation in behavioral intervention

that mitigates their problem behaviors (29, 40, 41). While another recent study (30) also suggests ongoing links between child behavioral problems, parent sleep, and parent affect, this is the first to demonstrate improvements in caregiver sleep and stress when a child's mental health symptoms are addressed with behavioral care (e.g., coaching and/or therapy). Given that a caregiver's sleep and stress are closely related to their child's sleep (5, 9, 20, 21), and children with mental health problems tend to have difficulty sleeping (22–24), these findings may reflect the downstream effects of child mental health treatment and related symptom changes on their caregiver's well-being (8). In other words, parents' sleep and stress may be linked to the improvements their child exhibits throughout involvement in a DMHI. However, it should be noted that the link between parent and child well-being is complex and multi-faceted, and many other factors that may moderate this association were not considered, such as caregivers' coping strategies and social support (42, 43). As such, further research is necessary to determine the causal mechanisms underlying these associations.

The current study also suggests that sleep problems are more common among caregivers who enroll their children in a DMHI than those in the general population. While an estimated 14.5% of adults in the general population report trouble falling asleep most days or every day (44), 48% of caregivers in the current study reported at least some insomnia symptoms (trouble falling asleep, staying asleep, or waking up too early) and 14% had clinically significant insomnia symptoms. It may be that caregivers who are seeking care for their children are experiencing increased stress, which in turn contributes to their sleep problems. Although further research is necessary, these elevated rates nonetheless highlight the persistent link between child mental health and caregiver sleep problems. As DMHIs for children and adolescents continue to develop, our findings highlight not only the potential of but also the need for secondary benefits to caregivers' sleep and stress.

4.2 Limitations and future directions

Although promising, findings from the current study are limited by several factors. Firstly, our sample was limited to those participating in a collaborative care DMHI, and thus our findings may not generalize to caregivers whose children are engaged in a different type of DMHI or a more traditional modality for mental health treatment. Additionally, our assessment of caregiver sleep was limited to the subjective measure of the ISI. While objective measures of sleep such as wearable devices and polysomnography are more accurate measures of sleep quality, sleep-disordered breathing, and sleep timing, the ISI has been validated in various clinical and non-clinical populations against objective measures of sleep (45, 46). However, future research should include an objective measure of sleep to more holistically quantify sleep quality and timing of caregivers.

In our assessment of caregiver sleep problems, caregivers may screen out of completing the full validated ISI assessment based on their responses to the screening questions. As such, the current analyses did not include follow-up assessment data for members who exhibited low insomnia symptoms after their first assessment. This lack of data among those arguably exhibiting the largest improvements likely skewed our longitudinal analyses to primarily reflect those with more persistent and severe insomnia symptoms. To mitigate this potential selection effect, caregivers' reductions in ISI scores or screening out on follow-up assessments were considered improvements in sleep problems. Moreover, our use of self-report only to report caregivers' sleep problems and parental stress may have not offered a complete picture of their symptoms. Further study is warranted using more objective measures of sleep (e.g., via sleep trackers) as well as child- or clinician-reported measures of parental stress.

Moreover, the current study did not include considerations of child symptom improvement throughout involvement at Bend Health, Inc. Future studies should assess whether improvements in caregiver sleep and parental stress may be predicted by changes in their child's symptom severity while receiving care from a DMHI. Previous studies have shown that caregiver sleep problems and parental stress are associated with their child's mental health problems (8, 25). Thus, better mental health outcomes of children in care with a DMHI may relate to larger improvements in their caregiver's sleep and parental stress. Alternatively, caregiver sleep and parental stress may improve regardless of their child's outcomes related to caregivers' feelings of relief and reduced stress when their children are receiving care. Assessing potential mechanisms underlying the positive association between child mental health and caregiver well-being, such as improvements in the parent-child relationship and reductions in family conflict.

Many potential covariates and confounding factors were not included in the present study. For example, we did not collect data on caregiver demographics such as sex, age, race and ethnicity, socioeconomic status, relationship to the child, marital status, and employment status. Caregiver involvement in parenting tends to vary based on caregivers' gender (with mothers typically more involved), socioeconomic status (parents of higher SES exhibit more involvement and warmth), and culture of origin (47–49). More specifically, caregiver participation and engagement in their children's mental health treatment specifically is positively linked to female gender, younger age, higher income, more education, and presence of both caregivers (43). We also did not consider other stressors that may impact caregivers' sleep and parental stress, such as psychiatric comorbidities, co-parenting, and work-related stressors (50). As such, further research is warranted.

Given the nascency of these research questions–especially as they pertain to DMHIs–it is unknown whether caregivers whose children are involved in DMHIs exhibit improvements in other indices of well-being, such as mental health symptoms, burnout, and productivity. These are crucial issues, given that an increasing number of caregivers are reporting poor mental health (51), feelings of burnout (52), and low workplace productivity due to their children's mental health (53, 54). In addition to these indices, future research should consider the associations between caregivers' well-being and their parenting behaviors

among families involved in DMHIs. Caregivers with low levels of parental stress tend to utilize positive parenting techniques more regularly (4, 12), and these techniques in turn can be crucial in facilitating children's involvement in mental health treatment (55). Finally, randomized controlled trials comparing DMHI participants to non-DMHI therapy groups and waitlist controls may help establish the causal mechanisms between children's mental health treatment via DMHIs and caregivers' well-being.

4.3. Concluding remarks

The current study offers promising preliminary evidence that caregivers of youth engaged in a DMHI show marked improvements in their sleep problems and parental stress, and the magnitude of these improvements is positively associated with the duration of care. These findings suggest that among families involved in DMHIs, the mental health of children is closely tied to the well-being of their caregivers. They highlight a unique opportunity for DHMIs such as Bend Health, Inc. to maximize their effectiveness and scope by considering caregivers as not only sources of support for their children, but as potential beneficiaries of the intervention as well. Considering the close association between caregiver well-being and child mental health care, employers should also consider making health benefits more holistic by offering mental and behavioral health care for employees' children. Ultimately, these findings highlight the potential benefits of family-centered digital mental health care, in which caregivers' therapeutic needs are considered alongside the needs of their children.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The data sets analyzed during the current study are not publicly available, as this would violate Bend Health Inc.'s privacy policy. However, aggregated and anonymized data that is not associated with individual users and does not include personal information is available from the corresponding author on reasonable request. Requests to access these datasets should be directed to darian.lawrence@bendhealth.com.

Ethics statement

The studies involving humans were approved by BRANY Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

LH: Conceptualization, Formal Analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. DL: Conceptualization, Formal Analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. JH: Supervision, Writing – original draft, Writing – review & editing. RG: Conceptualization, Writing – original draft, Writing – review & editing. MR: Funding acquisition, Writing – review & editing. KR: Funding acquisition, Writing – review & editing. AP: Writing – review & editing.

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Conflict of interest

All authors are employed or contracted with Bend Health Inc., which delivered the treatment used in this retrospective study. However, authors' employment status and salary are not dependent upon the results of their research. Author JH was employed by FitMinded, Inc.

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Comprehensive dialectical behavior therapy for adolescents in a juvenile correctional treatment center: a pilot evaluation

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Background: Incarcerated youth commonly present with emotion dysregulation, aggression, and comorbid psychiatric disorders, yet often do not receive necessary mental health treatment while confined. It is therefore crucial to expand the evidence base regarding empirically supported mental health interventions which are feasible to implement in secure settings to address incarcerated youth's mental health needs. Through a community-academic partnership, the current pilot study evaluated a comprehensive dialectical behavior therapy program implemented in a juvenile correctional treatment center.

Methods: Youth participants (N = 113) were on average 15.37 years old (SD = 1.10, range = 13–17), 68.1% boys, and identified as 69.0% Latinx, 22.1% Black, 8.0% White, and 0.9% Native American. Youth received comprehensive dialectical behavior therapy for adolescents (DBT-A), including individual therapy, skills training groups, family therapy, multi-family skills training groups, and skills coaching in the milieu by direct care staff who participated in extensive training and ongoing consultation team meetings. As part of a facility-designed program evaluation, youth completed a battery of empirically validated assessments of mental health and emotion regulation prior to and following completion of the program.

Results: Results show that comprehensive DBT-A is feasible to implement in a juvenile correctional treatment center and overall, youth improved from pre- to post-treatment in mental health symptoms and emotion regulation, with small to medium effect sizes.

Conclusion: These findings build upon a growing literature showing dialectical behavior therapy is a promising intervention for treating emotion dysregulation and mental health conditions and can be successfully implemented in juvenile forensic settings.

KEYWORDS

dialectical behavior therapy for adolescents, forensic psychology, adolescent, mental health, juvenile justice

1. Introduction

On any given day, approximately 43,580 youth are confined in the U.S. due to involvement with the juvenile or criminal legal systems; these 2017 estimates represent an approximately 60% reduction from a high of 108,802 in 2000 (1). Numerous studies have identified high rates of mental health needs among incarcerated youth, with estimates up to 80% having at least one psychiatric disorder (2–8). Epidemiologic data from incarcerated youth indicate half of boys and almost half of girls meet criteria for a substance use disorder, more than 40% of boys and girls for disruptive behavior disorders, and almost 20% of boys and more than 25% of girls for affective disorders (6, 9). Comorbid psychiatric disorders (e.g., affective, anxiety, behavioral, substance use) are also common; 56.5% of girls and 45.9% of boys meet criteria for two or more disorders (10). Incarcerated youth commonly present with extensive trauma histories (11), aggression and emotional dysregulation (12, 13), and are likely to experience re-incarceration as adults, substance abuse, financial difficulty, adverse health outcomes, and early mortality (14–17).

Incarcerated youth face multiple layers of stress and marginalization, requiring thoughtful implementation of evidence-based practices. Racism, poverty and community violence are some commonly experienced social determinants of health that may precipitate mental health needs, limit access to timely and quality mental healthcare and expedite entry into the legal system (18–24). Implementation of evidence-based interventions must strive to reduce the trauma and violence frequently encountered inside facilities, impacting both youth (e.g., peer-to-peer violence, seclusion as punishment) and staff (e.g., assaults on staff) (25, 26). Facility-wide efforts to reduce trauma exposure, address mental health needs, and prevent future legal involvement are desperately needed.

Dialectical behavior therapy (DBT), which was originally developed to treat adults exhibiting suicidal behavior (27), utilizes acceptance, behavioral change, and cognitive intervention strategies collaboratively with clients to achieve behavioral targets, prioritized by order of severity. Priority treatment targets include behaviors harmful to self and/or others, followed by therapy- and quality of life-interfering behaviors, other symptom relief, achieving individual goals and greater self-respect, in service of building a "life worth living." DBT teaches adaptive core skills of mindfulness, distress tolerance, interpersonal effectiveness, and emotion regulation. Due to its effectiveness in promoting the development of emotional and behavioral management skills, DBT has been adapted to treat conditions associated with emotional dysregulation [e.g., oppositional defiant disorder, eating disorders; (28–30)] and to build positive emotions, resilience, and social-emotional learning (31, 32).

DBT's adaptation for adolescents (DBT-A) incorporates families into treatment and a middle path skills training module, which seeks to synthesize two seemingly opposite positions common to parent-child relationships [e.g., over-pathologizing normal behavior vs. normalizing pathological behavior; (33)]. To attain optimal results, comprehensive DBT-A includes: (1) individual therapy, (2) group skills training to teach skills and enhance capabilities, (3) coaching to ensure generalization of acquired skills, (4) family DBT "as needed" to teach caregivers skills and for structuring the environment in support of treatment, and (5) consultation teams to provide support, enhance skills, and increase motivation among providers (34).

DBT has also been adapted for incarcerated populations (DBT Corrections-Modified; DBT-CM) (35), with modifications to the manual language and content of "real life" scenarios to make them more understandable and relevant (e.g., vocabulary and pictures for the lower educational level common to incarcerated populations). Skills training also includes plans for after release (36). DBT-CM has been implemented in juvenile correctional settings and found to reduce aggressive behavior, suicidal ideation, and recidivism (36–38).

Comprehensive DBT has better outcomes than without all DBT elements (39). It involves training for youth and staff, which is crucial given evidence that implementation of trauma-informed practices addresses correctional violence only if a certain threshold of both youth and staff are trained (40). A recent scoping review revealed eight published studies evaluating the effectiveness of DBT in secure youth forensic settings (41). Existing literature on DBT within these settings is limited and relies on predominantly small sample sizes of youth (i.e., half had 90 or fewer participants) in single facilities and using within-subjects designs without comparison conditions. No studies reviewed evaluated comprehensive DBT; one intended to, however environmental demands prevented them from doing so (42). This review also documented how implementation of DBT in these settings can be challenging due to lack of resources, lack of staff or staff turnover, or uncertainty about best practices for program implementation (43, 44).

The current pilot study was an academic-community partnership examining a comprehensive DBT-A program implemented in a long-term, post-adjudication juvenile correctional treatment center. The aim was to gather preliminary evidence regarding the impact of participating in comprehensive DBT-A on youth mental health and emotion regulation. It was hypothesized youth would exhibit improvements in emotion regulation and mental health. This pilot study also aims to document one facility's approach to implementing comprehensive DBT-A, in the hopes that lessons learned could guide other facilities interested in developing such programs.

2. Method

2.1. Facility

Participants resided in a county-operated 96-bed juvenile correctional treatment center serving adolescent boys and girls. Youth are court ordered to this secure facility, typically after multiple adjudications and efforts to provide community-based supervision and treatment. All youth in the facility receive

comprehensive DBT-A from a multidisciplinary treatment team; youth can also receive psychiatric care and substance use treatment, as needed. The facility was selected because of the: (1) established multidisciplinary treatment structure which facilitated effective coordination of DBT-A; (2) average length of stay for youth in the facility, which allowed the opportunity to complete all skills training modules (approximately 6 months); and (3) population of English-speaking youth who had been difficult to engage in lesser intensive settings and with other treatment modalities but had not yet been convicted of an aggravated crime which typically would lead to the commitment to the state juvenile system.

2.2. Program

In 2017, the county obtained grant support to acquire intensive training and consultation in the implementation of comprehensive DBT-A. DBT-A was selected due to its developmental appropriateness (e.g., skills training to help adolescents resolve age specific challenges, incorporates family); the curriculum was adapted to include elements of DBT-CM and DBT for substance use disorders to meet the specific needs of incarcerated youth.[1]

2.2.1. Staff training

All participating administrators, medical, educational, mental health and direct care staff participated in a yearlong intensive training schedule including: (1) introduction of the DBT-A model to executive leadership during one 8-hour session; (2) four 8-hour sessions with clinicians on utilizing DBT-A within individual, group, and family sessions; (3) five 8-hour sessions with clinicians, correctional supervisors, and direct care staff on implementing skills training modules within the milieu; (4) five different consultation teams discussing implementation issues with the expert trainer for 2 h per month over 6 months; and (5) another 8-hour session with executive management to review progress and formulate future plans. Ongoing consultation with the DBT trainer and annual booster training for the entire facility has continued since. Regarding turnover, the introductory DBT-A training is offered with each new officer orientation. Two DBT coaches (mid-level correctional staff) also provide shoulder-to-shoulder training and coaching as staff utilize DBT-A in their daily interactions with teens.

2.2.2. DBT-A components

Participating youth received the following services from trained master's level licensed clinicians: (1) weekly individual therapy; (2) weekly skills training groups; (3) bi-weekly family therapy; and (4) multi-family skills training groups. Youth also had access to skills coaching in the milieu by direct care staff, designated DBT coaches, and clinicians. Diary Cards were completed weekly and reviewed in individual therapy. Behavior Chain Analyses were completed regularly for effective and ineffective behaviors. Families were invited to attend biweekly family therapy with their teen, weekly visitation hours, and multifamily DBT focused sessions. Parental attendance was documented for family therapy and multifamily sessions and included in reports to probation and the court with annual participation rates ranging from 80%-92%.

Once youth completed all 18 skills groups and the accompanying homework, they took a DBT Competency Exam and participated in a coaching role play to determine whether they fundamentally grasped DBT-A concepts; in the history of the program, except for two youth, all have passed this exam on their first attempt. Youth then participated in a three-week Crime Review group (adapted from DBT-CM) led by a DBT-A clinician, completing a behavior chain analysis on their referring offense and learning skills that could have been used to interrupt the chain of events. Youth also participated in a Graduation Review presentation in which they acknowledged their accomplishments in placement, shared their therapeutic gains, and discussed their future plans.

Multidisciplinary treatment teams met weekly to address youth's treatment needs, progress, and award incentives. These teams ensured youth made progress toward treatment targets and directed adaptations as needed to meet any individual needs. Treatment targets on diary cards were evaluated to ensure they were realistic and attainable, and specialized interventions were developed for additional support in achieving these targets (e.g., individual coaching in the milieu to understand instructions and manage transitions and feelings in the moment). Clinicians and direct care staff utilized DBT-A strategies such as validation, "foot in the door" and "pros and cons" to encourage willingness to engage in treatment. With full recognition of the external pressures experienced by youth as the result of incarceration and court-mandated requirements for release, it was especially important to avoid coercive demands for compliance in favor of an emphasis on acceptance and validation.

Consultation Teams provide emotional support and validation for direct care staff and mental health providers, help ensure treatment fidelity, improve provider capabilities and reduce burn-out (45, 46). Mental health providers had regular consultation team meetings and the Staff Education and Support Meeting functioned as the Consultation Team for direct care staff; correctional supervisory staff regularly attended and direct care staff rotated attendance due to shift schedules (47). Clinicians facilitated these meetings to validate experiences working with youth and promote learning and practicing DBT-A skills which they, in turn, can offer as they coach youth within the milieu.

The facility's behavioral intervention plan was improved to align more generally with DBT-A principles and emphasize supportive and trauma informed approaches. The reward system focused on encouraging skillful behavior through increasing privileges and autonomy and discouraging unskillful behavior through consequences designed to expand learning opportunities. Youth exhibiting harmful or severely program disruptive

[1]Additional details regarding the implementation plan, training materials, and adapted intervention materials are available upon request to Anne Thomas (athomas1234@att.net).

behavior requiring separation from the general population were expected to follow the Egregious Behavior Protocol; they completed a behavior chain analysis of the incident and reviewed it with staff to identify unique vulnerabilities and triggers leading to the incident and to determine specific skills or behavior necessary to prevent future incidents. Youth remained on protocol until completion of the repair consisting of correction/overcorrection. Youth corrected damage caused by their behavior (e.g., fixing or paying for property they destroyed, working to repair damage to relationships) and overcorrected by identifying, learning, and practicing a new behavior or skill designed to break the old behavioral pattern.

2.3. Participants

Youth included in the current analysis ($N = 212$) participated in the comprehensive DBT-A program from its 2017 inception through October 2021. Youth who completed pre- and post-tests ($n = 113$) were the primary analytic sample. Youth who were missing post-test information were not included in primary analyses ($n = 99$); these youth did not significantly differ from those included on any demographic factors or primary variables of interest at pre-test. Type of discharge differed between those included (92.0% successful, 3.5% unsuccessful, 0.9% alternate placement, 3.5% probation expired) and excluded (65.7% successful, 26.3% unsuccessful, 1.0% alternate placement, 4.0% probation expired, 3% unknown). Excluded youth were significantly more likely to have an unsuccessful discharge and included youth were significantly more likely to have a successful discharge ($X^2 = 23.86$, $p < .001$); alternate placement and probation expired were not included in the comparison given the small cell sizes.

2.4. Measures

Eight master's level clinicians (full-time facility employees delivering DBT-A) administered the following self-report measures within 30 days of admission (pre-test) and 30 days before discharge (post-test). Clinicians also recorded youth demographic information.

2.4.1. Difficulties in emotion regulation scale short form (DERS-Sf)

The DERS-SF (48) is an 18-item assessment of an individual's ability to manage feelings. Responses are rated from 1 (almost never) to 5 (almost always) and averaged to create six, three-item subscales: strategies (α: pre = .49, post = .72), non-acceptance (α: pre = .72, post = .76), impulse (α: pre = .88, post = .90), goals (α: pre = .86, post = .86), awareness (α: pre = .74, post = .82), and clarity (α: pre = .66, post = .65); item level data to calculate alphas was only available for a subset of youth ($n = 80$–96 depending on subscale and timepoint) and the remainder had subscale scores only. Higher scores reflect greater emotion dysregulation.

2.4.2. Beck youth inventories, 2nd edition (BYI-2)

The BYI-2 (49) is a 100-item assessment of emotional and social impairments. Responses are rated from 0 (never) to 3 (always) and summed to create raw totals for five, 20-item subscales: self-concept, anxiety, depression, anger, and disruptive behavior. Raw scores are converted to t-scores using age- and gender-based norms. T-scores are interpreted as: 55 or less = average, 55–59 = mildly elevated, 60–69 = moderately elevated, and 70+=extremely elevated; for self-concept, t-scores in the elevated ranges reflect more positive self-concept compared to peers. BYI-2 data was only available for a subset of the sample (approximately 40%) primarily due to measure supply shortages. Item-level data used to calculate alphas was available for only a subset of those youth ($n = 29$–34 depending on subscale and timepoint). Alphas at pre- and post-test, respectively are: self-concept (.88,.88), anxiety (.92,.88), depression (.92,.93), anger (.94,.92), and disruptive behavior (.88,.88).

2.4.3. Adolescent anger rating scale (AARS)

The AARS (50) is a 41-item assessment of anger responses. Responses are rated from 1 (hardly ever) to 4 (very often) and summed to created three subscales: Instrumental Anger (20 items), Reactive Anger (8 items), and Anger Control (13 items); the raw total for the subscale anger control is subtracted from the sum of the instrumental and reactive anger subscales to obtain a total anger subscale. Although the assessment has grade- and gender-based norms, the current study compared the raw total scores because: (1) youth in the facility are on average 2 grades behind their same-age peers, often due to frequent moves and truancy (based on facility data), and (2) the grade level of most youth was not recorded at the time the measures were administered. AARS data was only available for a subset of the sample (approximately 61%) also because of measure supply shortages. Alphas at pre- and post-test, respectively are: instrumental anger (.84, .85), reactive anger (.85, .82), and anger control (.75, .82).

2.4.4. Trauma symptom checklist for children (TSCC)

The TSCC (51) is a 54-item measure of youth posttraumatic symptomatology. Items are rated from 0 (never) to 3 (almost all the time), summed to create raw scores, and converted to t-scores using age- and gender-based norms. Clinical scales include: Anxiety (9 items; α: pre = .80, post = .70), Depression (9 items; α: pre = .84, post = .76), Anger (9 items; α: pre = .89, post = .82), Posttraumatic Stress (10 items; α: pre = .89, post = .82), Dissociation (10 items; α: pre = .85, post = .81), and Sexual Concerns (10 items; α: pre = .73, post = .74). Twenty-two items are included in multiple subscales. The TSCC also includes validity scales assessing under- and hyper-reporting.

2.4.5. Juvenile victimization questionnaire, 2nd revision, reduced item (JVQ-R2)

The JVQ-R2 (52) is a 12-item shortened version of the original Juvenile Victimization Questionnaire (53). Youth respond yes or no to each item asking if they have experienced the following

types of victimization: emotional maltreatment (2 items), witnessing (3 items), physical maltreatment (4 items), property assault (1 item), and sexual victimization (2 items). The cutoff for polyvictimization is 5 or more endorsed items.

2.5. Plan of analysis

All analyses were conducted using SPSS v.28 statistical software. Preliminary analyses included descriptive statistics of all study variables. Dependent samples t-tests were used to assess pre/post changes in emotion regulation and mental health symptoms. Cohen's d was calculated as a measure of effect size and is interpreted following Cohen's (1988) established guidelines (0.20 = small, 0.50 = medium, 0.80 = large) (54).

We also examined whether pre-test demographic and mental health characteristics were related to type of discharge from the program (successful vs. unsuccessful). These analyses incorporated the full sample for whom type of discharge was known ($n = 198$). Chi-square tests were used for categorical variables (e.g., gender, race and ethnicity) and t-tests for continuous variables (e.g., mental health variables, age, length of stay).

3. Results

3.1. Sample characteristics

Youth ($n = 113$) were on average 15.37 years old ($SD = 1.10$, range = 13–17), 68.1% boys, and identified as 69.0% Latinx, 22.1% Black, 8.0% White, and 0.9% Native American. At pre-test, 95% of youth reported lifetime trauma exposure. Additional characteristics are presented in Table 1.

TABLE 1 mental health and trauma exposure characteristics of juvenile correctional center youth participants (2017-2021).

Characteristic	Descriptive statistic
Trauma history	
Trauma exposure, *M(SD), range*	6.39 (2.71), 0–12
Polyvictimization (% who endorsed 5 + items)	77%
Beck youth inventories clinical elevations, % (*n*)	
Anxiety	26% ($n = 16$ of 62 responses)
Depression	31% ($n = 19$ of 61 responses)
Anger	34% ($n = 21$ of 61 responses)
Disruptive behavior	59% ($n = 36$ of 61 responses)
Self-concept	34% ($n = 21$ of 62 responses)
Trauma symptom checklist for children clinical elevations, % (*n*)	
Anxiety	9% ($n = 10$ of 107 responses)
Depression	9% ($n = 9$ of 98 responses)
Anger	8% ($n = 9$ of 107 responses)
Posttraumatic stress	14% ($n = 15$ of 107 responses)
Dissociation	18% ($n = 19$ of 107 responses)

3.2. Changes in emotion regulation and mental health symptoms

Results are displayed in Table 2. Improvements in emotion regulation were observed on the DERS-SF, in all subscales except non-acceptance, representing small to medium effects (d's = 0.20–0.37). Improvement in anger control on the AARS was also observed, with medium effect sizes for total, instrumental, and reactive anger ($d = 0.50$–0.68) and a small effect ($d = .21$) for anger control.

Improvements in mental health were observed on all TSCC domains except sexual concerns, representing small to medium effect sizes (d's = 0.20–0.45). Most youth (72.6%, $n = 77$) produced valid TSCC responses, with no significant elevations on the under or overreporting subscales at pre- or post-test. At pre-test, 15.0% of respondents were elevated on the underreporting subscale and 3.7% on the overreporting subscale. At post-test, 17.3% of respondents were elevated on underreporting and 0.9% on overreporting. Analyses of TSCC data were conducted excluding respondents with elevations on validity scales; findings were consistent with analyses of the full sample, with the exception sexual concerns. Anxiety [$t(76) = 1.90$, $p = .030$, $d = 0.22$], depression [$t(76) = 2.84$], $p = .003$, $d = 0.32$), anger, $t(76) = 4.05$, $p < .001$, $d = 0.46$), posttraumatic stress [$t(76) = 2.35$, $p = .011$, $d = 0.27$], and dissociation [$t(76) = 3.62$], $p < .001$, $d = 0.41$) all improved; no changes were observed in sexual concerns [$t(75) = 0.18$, $p = .276$, $d = 0.07$].

Improvements in mental health on all domains of the BYI were also observed, reflecting small to medium effects (d's = .36-0.51).

3.3. Characteristics related to type of discharge

Boys were significantly more likely to be unsuccessfully discharged and girls more likely to be successfully discharged than expected ($X^2 = 4.05$, $p = .044$). There were no significant differences in type of discharge based on age, race, ethnicity, length of stay in the facility, or any mental health characteristic at pre-test.

4. Discussion

The current pilot study evaluated a comprehensive DBT-A program in a juvenile correctional treatment center. Consistent with prior studies of DBT in juvenile incarceration settings, improvements in mental health symptoms and emotion regulation were observed from pre- to post-treatment (36, 55, 56). This is promising given the documented high rates of mental health symptoms and disorders among incarcerated youth, as well as their elevated risk for suicide (57). Furthermore, evidence indicates improving emotion regulation during incarceration reduces the likelihood of youth recidivism (58). These findings build upon a growing literature showing DBT is a promising intervention for treating emotion dysregulation and can be successfully implemented in juvenile forensic settings (28–30).

TABLE 2 Changes in emotion regulation and mental health symptoms following participation in a comprehensive DBT program.

Assessment	*n*	Pre-test	Post-test	Difference		*t*	d
		M (*SD*)	*M* (*SD*)	*M* (*SD*)	95% CI		
Difficulties in emotion regulation scale							
Strategies	110	2.24 (0.98)	1.86 (0.86)	0.39 (1.04)	0.19, 0.58	3.91***	0.37
Non-acceptance	110	1.80 (0.91)	1.67 (0.89)	0.13 (1.11)	−0.08, 0.34	1.26	0.12
Impulse	110	2.78 (1.18)	2.32 (1.16)	0.46 (1.42)	0.19, 0.73	3.40***	0.32
Goals	110	3.18 (1.19)	2.85 (1.09)	0.33 (1.33)	0.07, 0.58	2.58*	0.25
Awareness	110	2.94 (1.09)	2.56 (1.15)	0.38 (1.14)	0.16, 0.59	3.48***	0.33
Clarity	110	2.10 (0.91)	1.92 (0.85)	0.18 (0.91)	0.01, 0.35	2.05*	0.20
Adolescent anger rating scale							
Total	66	90.83 (16.37)	80.95 (13.94)	9.88 (17.07)	5.68, 14.08	4.70***	0.58
Instrumental anger	67	33.46 (8.61)	28.72 (6.95)	4.75 (9.55)	2.42, 7.08	4.07***	0.50
Reactive anger	67	19.84 (5.93)	16.25 (5.11)	3.58 (5.28)	2.30, 4.87	5.56***	0.68
Anger control	67	27.01 (7.47)	28.84 (7.31)	−1.82 (8.52)	−3.90, 0.26	−1.75*	0.21
Trauma symptom checklist for children							
Anxiety	104	49.96 (10.59)	46.85 (7.78)	3.12 (10.76)	1.02, 5.21	2.95**	0.29
Depression	104	49.13 (9.28)	46.05 (7.56)	3.08 (9.09)	1.31, 4.84	3.45***	0.34
Anger	104	49.82 (9.76)	45.32 (7.21)	4.50 (9.94)	2.57, 6.43	4.62***	0.45
Posttraumatic stress	103	52.31 (11.26)	49.53 (9.88)	2.78 (10.33)	0.76, 4.80	2.73**	0.27
Dissociation	103	52.72 (12.20)	49.73 (10.08)	4.28 (11.46)	2.04, 6.52	3.79***	0.37
Sexual concerns	102	50.56 (15.82)	48.72 (11.79)	1.84 (13.98)	−0.90, 4.59	0.18	0.07
Beck youth inventories							
self-concept	44	44.18 (12.13)	49.95 (9.32)	−5.77 (12.95)	−9.71, −1.84	−2.96**	0.45
Anxiety	44	55.68 (10.90)	51.36 (8.95)	4.32 (10.31)	1.18, 7.45	2.78**	0.42
Depression	43	53.30 (9.81)	48.91 (7.93)	4.40 (9.53)	1.46, 7.33	3.02**	0.46
Anger	43	56.40 (11.95)	51.49 (9.68)	4.91 (13.59)	0.73, 9.09	2.37*	0.36
Disruptive behavior	43	63.93 (12.10)	56.98 (11.44)	6.95 (13.62)	2.76, 11.15	3.35***	0.51

*$p < .05$.
**$p < .01$.
***$p < .001$.

Implementation required significant resources and commitment from the county and facility. Prior studies show comprehensive DBT can be difficult to implement in juvenile correctional settings due to lack of resources, insufficient staffing, and uncertainty about how best to implement the program (43, 44). Implementation was costly due to the scarcity of expert training available, need for intensive initial training followed by ongoing training and consultation to minimize learning loss and consultation to ensure fidelity, and the importance of acquiring essential therapeutic resources (e.g., trauma-informed care intervention tools, incentives); for many facilities this approach is cost prohibitive.

The institution's multidisciplinary organizational structure was crucial to facilitating implementation, however this may not be standard in other facilities. Comprehensive DBT can be challenging to implement due to limited communication and coordination of interventions by mental health and correctional staff (59). Put simply, mental health staff often incorporate acceptance-based interventions (e.g., increasing self-awareness, validating emotions) whereas correctional staff interventions are generally change-based (e.g., environmental structure using a plan of contingencies to modify behavior). Comprehensive DBT is unique in seeking to enhance mutual understanding between these two seemingly opposite approaches, as illustrated by one of its fundamental assumptions: People may not have caused all their problems (acceptance), yet they must solve them anyway (change).

Successful comprehensive DBT-A implementation required a commitment to truly collaborative work to create fully functioning multidisciplinary teams sharing the goal of accepting the youths' experiences, perspectives, feelings and thoughts as valid while simultaneously helping them navigate systems of accountability. The legal system has not demonstrated effectiveness in reducing recidivism or improving youth wellbeing, so clinicians and correctional staff can use DBT to balance acceptance of limitations and work toward necessary change of the systems they uphold. Building effective communication to overcome distrust and improve collaboration between treatment and corrections professionals is addressed specifically in consultation team meetings. Effective DBT multidisciplinary teams work to find solutions so youth obtain the intended benefit of the treatment tool while at the same time, minimize potential risks of harm to self and others within the facility.

4.1. Strengths, limitations, and future directions

This study adds to the literature as it is the first evaluation, to our knowledge, of comprehensive DBT-A in a secure youth

forensic setting. Strengths include use of empirically validated assessments, inclusion of girls and boys and an ethnoracially diverse sample, and a larger sample than most prior studies evaluating DBT in secure youth incarceration settings (41). This pilot study also reflects real-world challenges to both the empirical analysis of treatment effects as well as the implementation of a comprehensive DBT-A treatment model in a juvenile correctional setting. First, the study relied on archival self-report data collected as part of a program evaluation involving a pre-post design and no comparison condition. This may limit confidence in the findings as change in outcomes could be due to maturation or timing effects or to other interventions received (e.g., psychiatric or substance use services). Federal protections for research with incarcerated youth necessarily limit the use of control groups, however future research should consider alternate designs (e.g., interrupted time series) to examine effectiveness (60). Although rigorous and valuable, randomized control trials are not always possible and alternate designs can provide useful evidence regarding the effectiveness of interventions (61). Future research should also incorporate behavioral (e.g., frequency of self-harm behavior) and collateral data (e.g., incident reports, frequency of restraint use) to understand the full impact of participation in DBT-A in a correctional setting.

Second, it is possible the sample was biased toward documenting improvements, as youth with available post-treatment data were more likely to be successfully discharged than those with only pre-treatment data. Discharge decisions are complex and treatment length therefore is individualized. Future studies should maximize post-treatment data collection from youth with unsuccessful discharges, including by providing opportunities to complete assessments post-release or in new placement settings.

Third, the current sample was from a single facility and impacted by the available resources. Running out of paid assessment measures and human-error (e.g., missing the backside of double-sided forms, youth refusal to complete full assessment batteries) resulted in missing data. Data gathering, management and analysis could be strengthened by establishing early partnerships with academic centers. Fidelity was supported through consultation team meetings and DBT coaches assisting staff, but not monitored systematically, a consideration for future studies.

Fourth, although our sample was racially diverse, analyses were not sufficiently powered to examine differential effectiveness of the intervention on youth from different ethnoracial backgrounds. Detailed data on youth ethnicity, beyond whether they identified as Latinx, was also unavailable. Future research should explore whether youth from certain ethnoracial groups and other identities (e.g., gender) benefit differentially from DBT-A.

Fifth, additional research is needed to examine the long-term effects of comprehensive DBT-A on youth and society more broadly. Our study was limited to examining changes in mental health and emotion regulation during incarceration; future research should examine impacts on post-incarceration outcomes such as recidivism, family cohesion and linkage to ongoing mental health treatment, as well as on staff burnout, turnover, and secondary traumatic stress. Finally, future research should consider the social and monetary cost of implementing comprehensive DBT-A in correctional settings as opposed to in the community.

5. Conclusion

Findings from the current study build upon a growing literature showing DBT-A is a promising intervention well-suited for treating emotion dysregulation and mental health conditions. With careful attention to the context of youth incarceration (e.g., punitive and mandated nature of incarceration, need for collaboration with legal system direct care staff), comprehensive DBT-A can be successfully implemented in secure juvenile forensic settings.

Data availability statement

Due to the sensitive nature of the data collected from incarcerated youth, data is not publicly available. Requests to access the datasets should be directed to Johanna Folk, johanna.folk@ucsf.edu.

Ethics statement

The studies involving humans were approved by The University Of Texas Health Science Center At San Antonio Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because this project was approved as "non-human subjects research"; only de-identified chart review data was used.

Author contributions

The first, second, third, and last authors conceptualized and drafted the first version of the manuscript. The first author conducted data analysis. The third author conceptualized the program implementation and data collection plan. The third and fourth authors assisted with data collection and management. All authors participated in the interpretation of findings and the writing and editing process. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Efficacy of behavior modification training combined with electroencephalographic biofeedback therapy for attention deficit hyperactivity disorder in children: a randomized controlled trial

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Background and aims: Attention deficit hyperactivity disorder (ADHD) is one of the most common psychiatric disorders in children. Multiple treatments are currently available with varying effectiveness, and our aim was to investigate the efficacy of behavior modification training combined with Electroencephalography (EEG) biofeedback treatment on ADHD in children.

Methods: Children with ADHD were randomly divided into a control group ($n = 42$), an EEG biofeedback group ($n = 30$) and a behavior modification training combined with EEG biofeedback group (i.e., a combined intervention group) ($n = 30$) according to the intervention. Swanson, Nolan, and Pelham, Version IV (SNAP-IV) and Conners Parent Symptom Questionnaire (PSQ) were assessed before and after three months of treatment.

Results: We found that in the EEG biofeedback group and the combined intervention group, the scores of all factors except "anxiety" and "psychosomatic disorder" were lower than before treatment, and the difference was statistically significant ($P < 0.05$). After treatment, the scores of the three groups were compared. The scores of "impulsivity-hyperactivity", "learning problems", "inattention factor" and "hyperactivity factor" were all lower than before, and the difference was statistically significant ($P < 0.05$). In the post-treatment comprehensive intervention group and the control group, the efficacy was apparent, and the differences in the scores of each factor were statistically significant ($P < 0.05$). In the comparison between the EEG biofeedback group and the control group, except for "anxiety", "psychosomatic disorder" and "conduct problem" the scores of each factor were statistically significant ($P < 0.05$). For the comparison between the integrated intervention group and the EEG biofeedback group, the scores of all factors before and after treatment were statistically significant ($P < 0.05$), except for "anxiety", "impulsivity-hyperactivity" and the scores of all the factors before and after treatment were statistically significant ($P < 0.05$), except for "anxiety", "impulsivity-hyperactivity" and "psychosomatic disorder".

Conclusions: The comprehensive efficacy of behavior modification training combined with EEG biofeedback therapy on the improvement of symptoms in children with ADHD is positive, and good compliance is worthy of clinical promotion. **Clinical Trial Registration:** https://www.chictr.org.cn/indexEN.html, identifier (ChiCTR2300071511).

KEYWORDS

behavior modification training, EEG biofeedback, therapy, attention deficit hyperactivity disorder, children

1. Introduction

Attention deficit hyperactivity disorder (ADHD) is one of the common neurodevelopmental disorders. The global prevalence of ADHD in children and adolescents is estimated to be approximately 5% (1–3). Research statistics show that the prevalence of ADHD in children is estimated to be 6.26% in China (4), with a significantly higher prevalence in boys than in girls. ADHD is mostly seen in school-aged children, and its core symptoms include hyperactivity, impulsivity or inattention that are not appropriate for their developmental age. Most of the symptoms persist into adolescence and even adulthood. Since ADHD is often comorbid with other disorders (5–7), such as mood, anxiety, and conduct disorders, it may have a wide and negative impact on the academic, occupational, and social life of patients (8). Therefore, an effective and highly compliant treatment modality is necessary.

The more common and accepted treatment modalities for ADHD are pharmacological and nonpharmacological treatments. Nonpharmacological treatments include EEG biofeedback and behavior modification therapy, which are designed to correct the behavior of children and improve their core symptoms. Clinical studies in the last decade have found (9, 10) that despite the positive efficacy of drug therapy, there may be safety hazards that affect children's development, such as loss of appetite and delayed height development, in the process of drug therapy (1, 11), and due to more parental concerns and resistance to give children long-term medication leading to poorer medication adherence. In addition, there are certain side effects of pharmacological treatments, such as anorexia, sleep disturbances, and headaches (9, 12). Some studies have shown that stimulants in drug therapy could not improve academic performance (13).

In recent years, EEG biofeedback has been widely used in the treatment of ADHD. Studies have found (14, 15) that EEG biofeedback therapy is effective in improving the core symptoms of ADHD. Previous studies also showed (16, 17) that children with ADHD have increased activity of theta waves and decreased activity of beta waves in the prefrontal center, and EEG biofeedback therapy is a method of extracting specific parameters from EEG signals as a reference for brain function training to suppress theta waves and strengthen beta waves (18–20).

With the intensive use of various behavioral therapies, it has been asked whether behavior modification training combined with EEG biofeedback for ADHD is more advantageous than a single treatment. In this study, we focused on the efficacy of behavior modification training combined with EEG biofeedback treatment for children with ADHD from this perspective, aiming to provide a basis for the standardized treatment of ADHD.

2. Materials and methods

2.1. Study participants

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Chaohu Hospital of Anhui Medical University (IRB No. 2019-kyxm-012). All children and parents signed an informed consent form. Children with ADHD who attended the outpatient clinic of the Department of Psychiatry of the Second Affiliated Hospital of Bengbu Medical College from July 2020 to Sep 2022 were selected as the study subjects. All children met the diagnostic criteria for ADHD in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) (21). Excluded were: (i) those who had left compulsory education; (ii) those with combined intellectual disability (IQ <70); (iii) those with severe physical illnesses, chronic infections, and other psychiatric disorders; (iv) children with schizophrenia, mood disorders such as childhood anxiety, depression, autism spectrum disorders, conduct disorders, tic disorders, and other comorbid disorders; (v) children who had taken medication for ADHD.

2.2. Research methodology

This study was an exploratory controlled clinical study. According to the preliminary experiment and literature review, the main efficacy index hyperactivity index decreased by about 0.2 ± 0.08 after treatment. We set Power = 0.9 and Alpha = 0.05 (bilateral), the sample size of three groups was 12 cases by PASS calculation. Assuming that the shedding rate of the subjects was 20%, the minimum sample size was 15 cases in each group.

A self-designed general situation questionnaire was used to collect general demographic data of the subjects, the PSQ and SNAP-IV (Parent Version) were evaluated. The groups were numbered according to the order of attendance at enrollment and then divided into a control group ($n = 42$), an EEG biofeedback group ($n = 32$), and an EEG biofeedback combined

with behavior modification training group (i.e., combined intervention group) ($n = 33$) using a random number table method. During the study, two children in the EEG biofeedback group were dislodged due to traveling (one child was dislodged after the third biofeedback session and another one was dislodged after the fifth biofeedback session), and 30 cases actually completed; one child in the integrated intervention group was dislodged due to the change of parents' jobs and the need to move to another city (dislodgment node: after the eighth biofeedback session), and two children were dislodged due to traveling (one of them was dislodged after the sixth biofeedback session, and the other after the eighth biofeedback session), and 30 cases were actually completed; no dislodgment was seen in the control group; 42 cases were actually completed. The treatment plan was formulated after comprehensive assessment of the three groups, in which the control group was not given any intervention; the EEG biofeedback group was given timely biofeedback treatment; and the comprehensive intervention group was given the same course of biofeedback treatment and behavior modification training. After three months of treatment, the scores of impulsivity-hyperactivity, hyperactivity index and SNAP-IV factors of the PSQ scale were assessed again in the three groups.

2.2.1. EEG biofeedback therapy

EEG biofeedback treatment was performed on two groups of children using a multiparameter EEG biofeedback instrument provided by Guangzhou Runjie Medical Equipment Co., Ltd., China. First, children were placed in a sitting position and allowed to quietly, relax in the training room for 3–5 min. Their faces were kept free of perspiration and foreheads were disinfected with alcohol. They were then connected the electrode cap, and given instructional language guidance. The children were encouraged to take the test seriously, and after the baseline test and alpha wave music relaxation, chose the corresponding game training program to suppress theta waves of 4–8 Hz and strengthen beta waves of 12–30 Hz. First, in the relaxation phase, the duration of alpha wave music relaxation was controlled at 3–5 min; second, in the biofeedback treatment phase, 3–5 game animations were selected, the treatment duration of each being controlled at 4–5 min, and each training period controlled at 15–25 min. Treatment was given 2–4 times per week (22, 23).

2.2.2. Behavior modification training

At least two psychiatrists or psychotherapists developed an individualized behavior modification treatment plan according to each child's condition (24–26). The operational procedures and training programs for behavior modification training were as follows: (i) Through interviews with parents to understand the composition of the family, parenting style and the child's personality and behavioral habits, factors affecting the child's inattention were identified, and parents trained, i.e., behavior parent training (BPT) (27–29). The training instructed parents on how to apply the principles of behavior modification in the home environment to improve their child's behavior. Parents had a weekly group session to share their experiences with each other, while the psychotherapist answered questions and solved problems. (ii) One-on-one communication with the affected child to help the child recognize his or her problems and at the same time be able to build confidence and courage to overcome undesirable behavior. (iii) Group attention training: Through different game settings, the child was allowed to understand the rules of the game, follow the rules and perform training activities. At the same time, anti-distraction training was conducted to instruct the child on how to distribute and focus their attention. When positive and appropriate behaviors emerged during training, praise and affirmation were given; when noncompliance with game rules and hyperactivity emerged, activities could be terminated and punished as appropriate, and attention was given to the application of behavior modification methods such as positive reinforcement, negative extinction and temporary isolation. This was especially true when hyperactivity and inattentiveness brought about adverse consequences; 1 to 2 times a week. (iv) Individual attention training: Depending on each child's situation, parents were asked to spend 20–30 min of individual attention training activities with their child at home every day, such as Schulte squares. The training program was regularly adjusted according to the actual achievement of the child.

2.3. Assessment tools and efficacy indicators

2.3.1. Self-made general information questionnaire

The homemade general information questionnaire was developed to remove some private information and collect the general information of the subjects, including gender, age, grade, and whether they were only children.

2.3.2. PSQ

The PSQ include the Teacher Questionnaire, Parent Questionnaire and the Parent Teacher Questionnaire (30). The revised parent questionnaire with 48 items was used in this study, including 6 behavioral problem factors: character problems, learning problems, psychosomatic problems, impulsivity-hyperactivity, anxiety, and hyperactivity index. A four-point scoring method from 0 to 3 was used. The factor scores and the hyperactivity index were used to determine which behavioral problems children had and their severity. Each factor score was the average of the scores of the included items. A score of greater than or equal to 1.5 on the hyperactivity index was considered positive for primary screening. The higher the score, the more likely the child was to have ADHD (31). In this study, the parents rated the children separately before and after treatment according to the content of the scale combined with their daily performance, and their main efficacy evaluation indices were the impulsivity-hyperactivity and hyperactivity index. The revised parent questionnaire of PSQ was also applied in many studies (32).

2.3.3. SNAP-IV

SNAP-IV is a commonly used screening tool for children with attention deficit hyperactivity problems and for efficacy assessment (33). The current commonly used version is the SNAP-IV-18, which includes a parent version and a teacher version. In this study, the parent version was used, and the scale included two factors, inattention and hyperactivity/impulsivity, with nine entries per subscale, using a four-point scoring system from 0 to 3. The subjects' total score on each subscale was first calculated, and then the mean value of each scale item (i.e., total subscale score/9) was calculated. The higher the score, the more severe the symptom, and a score of less than 1 was the normal range. If the score was greater than or equal to 1.6, ADHD was identified. If the score was between 1.1 and 1.5, then at least five items must have been scored as 2 (moderate) and/or 3 (severe) to be identified as ADHD (34). The parent version of SNAP-IV was also applied in previous studies (35).

2.4. Quality control and safety evaluation

All interventions in this study were performed under the guidance of psychiatrists or psychotherapists. All treatments were carried out in strict accordance with a uniform operational procedure, and the performance and efficacy of the children were recorded in a timely manner, with timely feedback and adjustment of the treatment plan as appropriate. Children who were unable to adhere to behavior modification training or EEG biofeedback treatment were allowed to withdraw from the study. Data entry in this study was performed by double entry to ensure the accuracy of the data entered. The EEG biofeedback treatment used in this study was safe and painless, and the children's compliance was high. Some children experienced itching at the location where the electrode cap was in contact with the forehead, and after adjusting the tightness of the electrode cap, the discomfort disappeared after ten minutes, and no other discomfort reactions were observed. The behavior modification training was mainly a game setting, and the children were very interested and complied well.

2.5. Data analysis and statistics

Statistical analyses were performed using SPSS software, version 17.0 (SPSS Inc., Chicago, USA). The variables were expressed as the mean ± standard deviation or frequency. Analysis of dichotomous variables such as the gender distribution of children in the three groups was performed by the chi-square test. For repeated variables, an independent samples *t*-test was used for comparison before and after treatment between two groups, and a paired *t*-test was used for comparison before and after treatment within groups. Analysis of variance (ANOVA) was used for comparisons between multiple groups, and the Least significant difference (LSD) method was used for two-way comparisons between groups. Differences were considered statistically significant at $P < 0.05$.

3. Results

3.1. General information

A total of 102 children were included in this study, with a mean age of (8.20 ± 1.653) years old: 82 males (80.4%) and 20 females (19.6%); 40 only children (39.2%) and 62 non-only children (60.8%). There were no statistically significant differences in age, sex or distribution of only children among the three groups ($P > 0.05$). There were no significant differences in the scores of the factors in the PSQ and SNAP-IV-18 between the three groups before treatment, as shown in **Table 1**.

3.2. Comparison of PSQ and SNAP-IV-18 scales before and after treatment in the EEG biofeedback and comprehensive intervention groups

After three months of intervention, no significant improvement was seen in the control group. A comparison between the EEG biofeedback group and the combined intervention group showed: (i) For PSQ, the scores of impulsivity-hyperactivity, hyperactivity index, learning problems and conduct problems were significantly lower than those before treatment, and the differences were statistically significant [e.g., hyperactivity index in the EEG biofeedback group (1.97 ± 0.38) vs. (1.45 ± 0.37), impulsivity-hyperactivity (1.40 ± 0.57) vs. (1.09 ± 0.56), hyperactivity index in the combined intervention group (1.88 ± 0.38) vs. (0.95 ± 0.42), impulsivity-hyperactivity (1.59 ± 0.36) vs. (0.86 ± 0.44), $P < 0.05$]; (ii) for SNAP-IV-18, the scores of inattention factor and hyperactivity factor in both groups were significantly lower than before The differences were statistically significant [e.g., inattention factor (2.04 ± 0.50) vs. (1.44 ± 0.46) in the EEG biofeedback group, inattention factor (1.76 ± 0.47) vs. (1.25 ± 0.48) and hyperactivity factor (1.54 ± 0.74) vs. (0.64 ± 0.53) in the combined intervention group, both $P < 0.05$], as shown in **Table 2**.

3.3. Comparison between the three groups before and after treatment

After three months of treatment, we found that (i) compared among the three groups, the scores of "hyperactivity index", "impulsivity-hyperactivity", "learning problems", "inattention factor" and "hyperactivity factor" were lower than those before treatment, and the differences were statistically significant ($P < 0.05$). (ii) Comparing the combined intervention group and the control group, the efficacy was significant and the differences in the scores of the factors were statistically significant [e.g., impulsivity-hyperactivity (0.86 ± 0.44) vs. (1.41 ± 0.41), conduct problems (0.67 ± 0.49) vs. (1.25 ± 0.46), (all $P < 0.05$)]. (iii) Comparing the EEG biofeedback group and the control group, the scores of all the factors before and after treatment were statistically significant except for "anxiety", "psychosomatic disorders" and "conduct problems" [e.g., hyperactivity factor (0.87 ± 0.56) vs.

TABLE 1 Comparison of general data distribution and baseline PSQ and SNAP-IV scales among the three groups of children.

Variables		Control group ($n = 42$)	EEG Biofeedback Group ($n = 30$)	Integrated intervention group ($n = 30$)	$X^2/F/t$	P*
Age (year)		8.14 ± 1.72	8.53 ± 1.55	7.93 ± 1.66	0.437[a]	1.025
Gender	Male	34	23	25	1.025[b]	0.362
	Female	8	7	5		
Only child	Yes	13	13	14	2.315[b]	0.347
	No	29	17	16		
PSQ						
Hyperactivity index		1.87 ± 0.35	1.97 ± 0.38	1.88 ± 0.38	0.739[c]	0.480
Anxiety		0.07 ± 0.15	0.15 ± 0.39	0.17 ± 0.26	1.509[c]	0.226
Impulsive-hyperactivity		1.42 ± 0.42	1.40 ± 0.57	1.59 ± 0.36	1.665[c]	0.194
Psychosomatic disorders		0.17 ± 0.40	0.22 ± 0.46	0.02 ± 0.06	0.965[c]	0.385
Learning issues		2.26 ± 0.44	2.34 ± 0.52	2.29 ± 0.48	0.245[c]	0.783
Character issues		1.25 ± 0.47	1.36 ± 0.45	1.24 ± 0.54	0.503[c]	0.606
SNAP-IV						
Inattention factor		2.04 ± 0.36	2.04 ± 0.50	1.76 ± 0.47	0.675[c]	0.512
Hyperactivity factor		1.57 ± 0.57	2.14 ± 0.40	1.54 ± 0.74	1.207[c]	0.303

Data were expressed as the mean ± standard deviation or *n*; The PSQ and SNAP-IV were used for baseline assessment in children with ADHD.
[a]Statistical values were expressed as *t*-values.
[b]X^2.
[c]ANOVA.
*$P > 0.05$.

(1.59 ± 0.56), learning problems (1.57 ± 0.46) vs. (2.24 ± 0.42), all $P < 0.05$]. (iv) The integrated intervention group and the EEG biofeedback group, the scores of all factors before and after treatment were statistically significant, except for "anxiety", "impulsivity-hyperactivity", and "psychosomatic disorders". (e.g., hyperactivity index (0.95 ± 0.42) vs. (1.45 ± 0.37), inattention factor (1.25 ± 0.48) vs. (1.44 ± 0.46), $P < 0.05$). As shown in Table 3.

4. Discussion

In this study, we found that behavior modification training combined with EEG biofeedback therapy was effective in the treatment of children with ADHD. The ADHD is a common neurodevelopmental disorder in childhood, which brings a heavy burden to patients, their families and society. The side effects of medication prevent children with ADHD and their families from taking medication (10, 36). Therefore, parents prefer to choose non-pharmacological treatment with high safety and few side effects.

In this study, the comparison between the EEG biofeedback group and the control group before and after treatment revealed that the factors of "impulsivity-hyperactivity", "inattention factor", and "learning issues" improved significantly. This indicated that biofeedback treatment can improve inattention and hyperactivity symptoms, which has been confirmed in many studies (37, 38).

TABLE 2 Comparison of PSQ and SNAP-IV-18 factor scores before and after treatment in the EEG biofeedback and comprehensive intervention groups.

Variables	EEG Biofeedback Group ($n = 30$)		t**	P	Integrated intervention group ($n = 30$)		t**	P
	Before treatment	After treatment			Before treatment	After treatment		
PSQ								
Hyperactivity index	1.97 ± 0.38	1.45 ± 0.37	10.771	<0.001*	1.88 ± 0.38	0.95 ± 0.42	24.217	<0.001*
Anxiety	0.15 ± 0.39	0.17 ± 0.29	0.465	0.645	0.17 ± 0.26	0.07 ± 0.11	2.11	0.043*
Impulsive-hyperactivity	1.40 ± 0.57	1.09 ± 0.56	5.656	<0.001*	1.59 ± 0.36	0.86 ± 0.44	17.012	<0.001*
Psychosomatic disorders	0.22 ± 0.46	0.15 ± 0.32	1.439	0.161	0.02 ± 0.06	0.01 ± 0.04	1.439	0.161
Learning issues	2.34 ± 0.52	1.57 ± 0.46	10.441	<0.001*	2.29 ± 0.48	1.28 ± 0.51	16.046	<0.001*
Character issues	1.36 ± 0.45	1.20 ± 0.45	5.326	<0.001*	1.24 ± 0.54	0.67 ± 0.49	11.930	<0.001*
SNAP-IV								
Inattention factor	2.04 ± 0.50	1.44 ± 0.46	10.77	<0.001*	1.76 ± 0.47	1.25 ± 0.48	7.02	<0.001*
Hyperactivity factor	2.14 ± 0.40	0.87 ± 0.56	20.15	<0.001*	1.54 ± 0.74	0.64 ± 0.53	11.67	<0.001*

The PSQ and SNAP-IV scores for each factor were expressed as the mean ± standard deviation.
*$P < 0.05$.
**Statistical analysis was expressed as *t*-value.

TABLE 3 Comparison of the scores of each factor between the three groups after treatment.

Variables	Control group ($n = 42$)	EEG Biofeedback Group ($n = 30$)	Integrated intervention group ($n = 30$)	F	P
PSQ					
Hyperactivity index	1.85 ± 0.35	1.45 ± 0.37[a]	0.95 ± 0.42[b,c]	50.145	<0.001*
Anxiety	0.17 ± 0.23	0.17 ± 0.29	0.07 ± 0.11[b]	2.265	0.109
Impulsive-hyperactivity	1.41 ± 0.41	1.09 ± 0.56[a]	0.86 ± 0.44[b]	12.606	<0.001*
Psychosomatic disorders	0.14 ± 0.31	0.15 ± 0.32	0.01 ± 0.04[b]	3.043	0.052
Learning issues	2.24 ± 0.42	1.57 ± 0.46[a]	1.28 ± 0.51[b,c]	41.433	<0.001*
Character issues	1.25 ± 0.46	1.20 ± 0.45	0.67 ± 0.49[b,c]	15.378	<0.001*
SNAP-IV					
Inattention factor	2.02 ± 0.32	1.44 ± 0.46[a]	1.25 ± 0.48[b,c]	60.054	<0.001*
Hyperactivity factor	1.59 ± 0.56	0.87 ± 0.56[a]	0.64 ± 0.53[b,c]	28.169	<0.001*

Data were expressed as the mean ± standard deviation.
[a]The EEG biofeedback group compared with the control group, $P < 0.05$.
[b]The Integrated intervention group compared with the control group, $P < 0.05$.
[c]The Integrated intervention group compared with the EEG biofeedback group, $P < 0.05$.
*Comparison between the three groups, $P < 0.05$.

However, there was no significant improvement in "anxiety", "psychosomatic disorders" and "conduct problems", which may be related to co-morbidities. It has been shown (39) that the core symptoms of ADHD are associated with a large number of psychiatric disorders such as behavioral disorders, learning disorders, anxiety disorders, and sleep disorders. Due to the high rate of co-morbidity, it may complicate not only the clinical presentation of ADHD but also the selection of the most appropriate treatment strategy (40, 41). Therefore, other comprehensive treatment options are needed to compensate, such as behavior modification training and family therapy. Whereas EEG biofeedback training is also a process of operant conditioning, children may suffer from decreased interest and burnout due to repetitive training, which may affect the efficacy. And behavior modification training seems to make up for such shortcomings.

Previous studies (42–44) have shown that behavior modification training can significantly improve hyperactive or inattentive behaviors in children with ADHD. In this study, the treatment effect of the integrated intervention group was significantly better than that of the EEG biofeedback treatment group, especially in the areas of "hyperactivity index", "inattention", "learning problems" and "behavioral problems". It indicates that the children's learning problems and behavioral symptoms were also synergistically improved, which was consistent with the study of Roy S et al. (45). The comparison between the EEG biofeedback group and the comprehensive intervention group revealed that the single EEG biofeedback training may lead to decreased interest, visual and psychological fatigue, and even passive resistance in some of the children due to repetitive training, which in turn may affect the efficacy. The integrated intervention group used behavioral modification training combined with EEG biofeedback treatment, and a series of game training was set up in the behavioral modification training, which resulted in a high sense of interest and participation of the children, greatly reducing the fatigue of the children, improving the children's adherence to the treatment, and enhancing the confidence of the children and their parents in adhering to the treatment.

In addition, the target of behavior modification in our study is not limited to children, but also parents, i.e., behavioral parent training (BPT). As we know, the etiology of ADHD is not only genetic, but also socio-family psychological factors, especially poor parental character and parenting style of the family. And the limitations of children's personality traits, behavior modification must require parental guidance and supervision. And BPT is used clinically as a proven, evidence-based treatment for pediatric ADHD (46, 47). It is particularly effective for children with ADHD who have disruptive behaviors (48, 49). In the study, parents gave weekly feedback on their children, and most parents reported that parent training helped children with personality problems, which can be quantified in future studies. For adolescents with ADHD, BPT has been categorized as a potentially effective treatment. This is consistent with the findings of Sibley et al. (2016) (50, 51).

Overall, in this study, the advantages of both EEG biofeedback therapy and behavior modification training include high safety, small adverse reactions, and long-term application. The combined use of the two not only makes the treatment more diversified, but also effectively improves the treatment compliance of the children. Through the training, the bad behavioral habits subsided, the good behavioral habits were strengthened, the core symptoms improved significantly, and the learning efficiency was improved.

Nevertheless, the study has some limitations. Firstly, the follow-up time is relatively short. Studies by some scholars in China have shown (52) that after one year of behavioral intervention, anxiety disorders and psychosomatic disorders associated with ADHD can be further improved. Subsequent follow-up can be continued by extending the follow-up time, etc., which may provide a stronger indication of clinical efficacy. Second, in this study, the validity of clinical symptoms was assessed mainly by parent questionnaires. Due to the epidemic and the summer vacation in China, it was not practical for teachers to participate in the assessment. Of course, if the parent questionnaire and the teacher questionnaire can be assessed at the same time, then it can be better to provide feedback on the effectiveness of the treatment. More systematic

and objective clinical assessment tools will be added to the study in the future. Meanwhile, the intervention targets of the behavior modification treatment in this study were mainly parents and children. Subsequent trial design may consider adding teacher training for school intervention, which may be more conducive to the improvement of ADHD clinical symptoms. Finally, there are many comorbidities of ADHD, and the selection of subjects in this study excluded the comorbidity sample, the results of this study may not be generalized to children with ADHD with comorbidities. In the future, the sample size should be further expanded to extend the treatment methods to other ADHD children with comorbidities.

In conclusion, the comprehensive efficacy of behavior modification training combined with EEG biofeedback therapy on the improvement of symptoms in children with ADHD was positive, and good compliance is worthy of clinical promotion.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by the Ethics Committee of Chaohu Hospital of Anhui Medical University. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was obtained from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

Conceptualization, XL and XZ; methodology, XL, LX, and XZ; formal analysis, XL; investigation, XL and LZ; data curation, XL, LX, and LZ; writing-original draft preparation, XL; writing-review and editing, XL, LX, LZ, and XZ; supervision, XZ. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author LX declared that he was an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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Broad spectrum micronutrients: a potential key player to address emotional dysregulation

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Psychiatric conditions are inherently multifactorial and must be understood and addressed within a multidimensional framework. Adequate nutritional intake is necessary for optimal mental health and is thus an essential component of any psychiatric treatment plan; this is especially true as many patients have a diet high in ultra-processed foods. However, due to a variety of factors such as individual biological and behavioral contributors, modern farming practices, and climate change, implementing a healthy diet alone may not be sufficient to satisfy nutritional requirements. Research studies on three formulations of broad-spectrum micronutrients (BSMs) have demonstrated significant efficacy in treating a range of mental health disorders. In particular, outcomes associated with emotional regulation via BSMs across a variety of psychiatric illnesses (ADHD, autism, trauma, mood disorders, nicotine dependence, and psychosis) to date have been positive.

KEYWORDS

nutritional psychiatry, nutrition, integrative medicine (IM), integrative psychiatry, broad spectrum micronutrients, supplements, ADHD treatment, nutraceuticals

Introduction

Children and adolescents in the United States are experiencing an unprecedented mental health crisis, which was accelerated by, but cannot be wholly attributed to, the COVID19 Pandemic. The CDC's Youth Risk Behavior Survey Data Summary & Trends Report: 2011- 2021 found that mental health among students has been steadily declining over the past decade (1). A reported 57% of female students and 29% of male students in 2021 expressed persistent feelings of sadness or hopelessness in 2021, up from 36% and 21% the decade prior. Additionally, 30% of female students and 14% of male students reported having seriously considered attempting suicide in 2021, up from 19% and 13% respectively the decade prior (2). Since our current system of care is, by the numbers, not sufficient, we must continue to consider and evaluate all potentially positive contributors to health and wellbeing.

A decade ago, a national survey found that approximately 12% of all children and adolescents and 50% of children and adolescents with chronic illness were reported to be using complementary and alternative therapies. Among these individuals, complementary approaches were most commonly used for colds, musculoskeletal pain, ADHD, and anxiety/stress (3). One may postulate that this points to a recognition in families of the need for more holistic and comprehensive interventions. It is thus critical that clinicians become familiar with complementary and alternative approaches so they may appropriately counsel patients on their safety and efficacy. With the rising popularity of complementary and alternative treatments by patients, physicians are increasingly seeking out education on how to provide appropriate guidance (4).

Proper nutrition is often intuitively accepted by clinicians and patients alike as essential to a healthy life. Research has indeed shown an association between a nutrient-dense diet and better mental health (5–8). Additionally, some studies have shown a correlation between a diet of nutrient-poor ultra-processed foods and the later onset of poor mental health, specifically, depression and anxiety (9–11). Minerals and vitamins are fundamental to maintaining a healthy brain as they support the brain's metabolic functioning, can act as anti-inflammatory agents, are involved in neurodevelopment, modulate genetic expression and cell signaling, and are involved in the production of neurotransmitters and in maintaining biochemical normalcy (12).

Can we obtain the necessary vitamins and minerals from our diet alone? It has been postulated that for some subset of individuals the answer is in fact no. The explanation is tied to both environmental and biological processes. Research across the globe indicates that there have been decreases in the concentrations of certain micro and macronutrients in crops over the last 70–150 years (13–15). Contributing factors include certain farming practices such as prioritizing yield over nutrient density or flavor (13), over tilling of the soil while fertilizing it with only limited essential nutrients (16), and the use of the herbicide glyphosate which may impair absorption of certain minerals such as iron, manganese and nickel (17) while further decreasing soil health (18). There is also concern that the ever-increasing concentration of carbon dioxide in the environment is leading to decreased nutrient density in crops; higher levels of CO2 appear to promote higher concentrations of carbohydrates with lower proportions of protein and micronutrients (15, 19, 20). Furthermore, some people have a congenital need for more than the typical amount of cofactors for optimal enzymatic activity. This may be explained, at least in part, by variation in genetic polymorphisms (21, 22).

What is a broad-spectrum micronutrient formulation and its potential clinical use based on current research?

The physiologic processes that underlie our mental health and wellbeing require a broad range of micronutrients working in concert. Earlier nutritional research efforts focused primarily on the impact and treatment of single micronutrient deficiencies (e.g., pellagra, scurvy, or Wernicke–Korsakoff Syndrome). Although deficiencies in some micronutrients have been reliably correlated with poorer mental health outcomes, in many cases when single deficiencies are corrected with mono-supplementation there are small to no effects shown in the literature on mental health and wellbeing (22). It can thus be postulated that the underlying issue is not dependent on a single nutrient deficiency, but rather that the entire system needs to be supplemented with a wide range of micronutrients. Popper (22) defines a broad-spectrum micronutrient (BSM) as a formulation or intervention that includes at least 10 different vitamins or minerals.

To date, independent scientists have studied the effectiveness of three commercially available BSM formulas: EMPowerPlus and its variations (https://www.truehope.com/), Daily Essential Nutrients (DEN) and its variations (https://www.hardynutritionals.com/), and the Autism Nutrition Research Center (ANRC) Essentials developed by Arizona State University (https://www.autismnrc.org/). We use the term "variations" to refer to the fact that over time the manufacturer has made slight modifications to their formula. Each formula has approximately 30 minerals and vitamins, along with selected amino acids and antioxidants. Each formula has also been shown in several studies, including RCTs, to affect mental health outcomes (23), which we will summarize here.

ADHD

Although the evidence supporting the efficacy of the current ADHD medications for core symptoms of ADHD is strong (24), addressing the often-comorbid emotional dysregulation of ADHD continues to be a challenge. Additionally, stimulant treatments may cause undesired side effects, such as worsening of emotional lability, anxiety (25), and appetite suppression/poor nutritional intake. Further complications include the existence of a notable subset of children with a variable and incomplete response to our current standards of treatment for ADHD, as well as the ongoing issues regarding the potential for misuse and/or diversion of stimulant medications. For example, in the Multimodal Treatment of Attention Deficit Hyperactivity Disorder Study (MTA) study, only 68% of participants who received both stimulant medication and behavioral therapy were considered successfully treated (26).

Early, open label studies were the first to demonstrate the potential use of BSM in ADHD showing improvements in core ADHD symptoms and/or associated behavioral dysregulation (27–29). More recently, given the very promising data from open label studies, high quality, randomized placebo-controlled trials of BSM have been conducted for ADHD. The first RCT in children included 93 medication-free 7–12-year-olds who were randomly assigned to either a group that received BSM or placebo capsules for a period of 10 weeks. Core ADHD symptom improvement was modest or low/not significant from placebo; however, BSMs had significant effects on measures of global functioning (CGI-I ES = 0.46; C-GAS ES = 0.48), inattention (CGI-I ADHD ES = 0.53), emotion regulation and aggression (CGI-I Mood ES = 0.51; Parent SDQ ES = 0.52; Teacher BRIEF—Emotional Control Subscale ES = 0.66) (30).

An additional analysis was conducted in this RCT to investigate possible predictors (e.g., serum nutrient status, sex, IQ, MTHFR genetic status) of treatment response across outcomes. There were no consistent predictors of positive response (31). A subsequent open label extension phase followed this group for 1 year. About 80% of those who continued BSMs were labeled as being in remission from their ADHD symptoms vs. 40% of those on medications and 20% of those who stopped all treatment. There were continued symptom improvements over time (32). The improvements observed in children who received BSMs in the short term were sustained during the 1-year follow-up period, and no adverse effects were noted. Similar results

were also seen in a naturalistic follow-up study of adults with ADHD (33).

In a multicenter RCT involving 126 children aged 6–12 diagnosed with ADHD, significant improvements were exhibited by those who received the BSM (34). Change was assessed using clinician-rated Clinical Global Impression-Improvement (CGI-I) scales, revealing a significant outcome ($p < .001$, RR = 2.97). Treatment responders, defined as those showing "much" or "very much improved" status according to the CGI-I scale, constituted 54% of the micronutrient-treated group, whereas only 18% of the placebo group were responders. Additionally, those in the micronutrient group grew an average of 6 mm more than those in the placebo group ($p = .002$, $d = 1.15$), not attributable to rebound from previous stimulant use. No serious adverse events or changes in blood/urine tests were found. This trial replicated safety and efficacy data of 2 other RCTs using a similar formula for patients with ADHD (30, 35).

These studies suggest that BSMs are very promising for the treatment of ADHD, particularly in those with emotional dysregulation.

Aggression

Aggression and rule breaking behavior, which often has an inherently complicated etiology for any one child, is a common presenting concern to child psychiatry clinics and ERs. There have been some investigations into the utility of using vitamin/mineral supplements to assist in treating these behaviors. The first RCT to consider this question involved 62 incarcerated youths ages 13–17. All were encouraged to improve their diet, but a subset was randomized to receive an additional broad spectrum supplement (11 minerals, 12 vitamins). Violence, non-violent rule violations, and total rule violations fell to a significant degree in the BSM group; the effect was even greater when compared to those in the placebo group who did not improve their diet (36).

Eighty schoolchildren aged 6–12 were studied in a RCT for 1 year to evaluate the effects of BSM on rule-breaking behavior (threats, fighting, vandalism, defiance, endangering others, disorderly conduct). It was found that those randomized to the BSM group displayed 47% fewer of these behaviors requiring discipline than those who received placebo (37).

Overall, there appears to be a clear relationship between vitamin/mineral intake and aggression (38). This could have significant ramifications for individuals and our communities; particularly in communities that do not have access to high quality, nutritious food.

Anxiety and stress

It has been postulated that stress and anxiety, in the activation of the fight or flight response, may increase micronutrient depletion and thus prolong the stress response. Initial outcomes regarding micronutrient supplementation in the reduction of stress and anxiety appear promising. In the open label extended phase of the ADHD study (29), parents reported decreased levels of anxiety in the children who continued BSMs. An open label trial of 17 children ages 8–11 investigating the effect of BSM on stress/anxiety following an earthquake reduced children's post-disaster anxiety by a clinically significant degree (39). Given the urgent need for better pediatric treatment of trauma and promising data in adults, further studies are needed in children to evaluate the effect of BSMs on stress, anxiety and PTSD. In adults, two unblinded RCTs investigated the effects of BSM supplementation on acute post-natural disaster stressors (flood, earthquake) compared to an active comparison (40, 41). The treatment duration ranged from 4 to 6 weeks. Rucklidge et al. (41) studied 91 adults with elevated depression, anxiety, or stress symptoms after the 2011 Christchurch earthquake; participants received either 4 or 8 capsules daily of EMP+ or a B complex as the active comparison. Kaplan et al. (40) studied 56 adults with similar symptoms after the 2013 floods in Alberta, Canada, comparing EMP+ with a B complex and vitamin D as active comparisons. Both studies used the Depression Anxiety and Stress Scale (DASS) as the primary outcome measure. Both studies reported significant reductions in symptoms within all treatment groups. In the Rucklidge study, high-dose EMP+ showed greater clinical improvement in mood, energy and anxiety compared to the B complex control. Kaplan's study found that both EMP+ and B complex were more effective than vitamin D in reducing anxiety and stress symptoms.

Autism spectrum disorders

Studies in those with autism show promising results for potential improvements in cognitive, emotional, and behavioral domains. A case control study of 44 people with autism ages 2–28 who were given BSM or an equivalent were compared to a matched group of 44 similar individuals who sought treatment as usual. Both groups showed improvement; however, the BSM group had a significantly larger decrease in scores on the Total Aberrant Behavior Checklist, self-injurious behavior intensity, and in improvements on the Clinical Global Impressions scale. The BSM group also reported fewer adverse events as compared to the medication as usual group (42).

Researchers at Arizona State University have been developing a BSM specifically for autism. A randomized placebo controlled 3-month study in children and adults with autism on an earlier version of the supplement showed improvements over placebo in the areas of hyperactivity ($p = 0.003$) and tantruming ($p = 0.009$). The data suggested a possible improvement overall ($p = 0.02$) as well as in receptive language ($p = 0.03$). Nonsignificant correlations were found in expressive language, play, cognition, GI, sleep, sociability (43). An open label research survey was conducted by the same researchers on their current formulation of the BSM. They found improvements over placebo (comparing survey participants to the placebo group of the previously mentioned RCT) by Parent Global Impressions of Autism with an estimated effect size of 0.66. When compared to data collected

from the National Survey on Treatment Effectiveness for Autism, the overall benefit scores of this study's respondents were higher than the average score of 28 psychiatric and seizure medications as well as the average score of 58 nutraceuticals. They also found that the BSM respondents had an overall low adverse effect score, which was slightly higher or comparable to the national data on nutraceuticals and much lower than that of the psychiatric/seizure medication group (44).

Mood disorders

To date, there is limited high quality research on the effect of BSM on mood disorders in children. A database analysis of parent reports of 120 children ages 7–18 showed 46% of the sample improved by at least 50% ($p < .001$, ES = 0.78), 35% of the sample improved by less than 50% and 19% of the sample had symptom worsening. For those who were treatment responders, the number of psychiatric medications used decreased by 74%. These data were collected by the manufacturer but independently analyzed by researchers (45). A case series of 3 children noted improvements in mood after 12 weeks of treatment with BSM by parent and child reports (46).

An open label case series of adults ($n = 11$) showed that upon introduction of BSMs, patients with bipolar disorder had an improvement of mood symptoms while simultaneously clinically managed on fewer psychotropic medications (more than a 50% reduction). This may indicate that when taken adjunctively, BSM may improve efficacy of psychiatric medication and lead to less polypharmacy and need for adjunctive medications in mood disorders (47). More studies are needed for this effect and to determine efficacy in cases of polypharmacy/treatment resistance.

Psychosis

There is limited data on the use of BSM in psychosis. There is one case study of the use of BSM in the treatment of an 11 year old male diagnosed with psychosis NOS, OCD, GAD, SAD, and borderline intellectual functioning. He had multiple failed medication trials due to intolerable side effects and lack of efficacy. Beginning with a Children's Global Assessment Scale (CGAS) score of 35, by 14 months of BSM treatment his CGAS score was 75 with remittance of psychosis, OCD, GAD, SAD (48). In adults, an open label study followed 19 adults with psychotic disorders for two years. At the end of the two years, when compared to a group who chose treatment as usual, those in the BSM group reported fewer psychotic symptoms, required smaller doses of medication to be effective, and had fewer medication side effects (49).

Substance Use

In a 12-week RCT, individuals with nicotine dependence ($n = 107$) were assigned to either a placebo group ($n = 50$) or a micronutrient group ($n = 57$); (50). The groups did not differ on the primary outcome of continuous abstinence at 12 weeks using intention-to-treat analysis (18% for placebo vs. 28% for micronutrient group, CI: 0.71–4.48). However, participants in the micronutrient group reported reduced cigarette consumption throughout the trial.

In a subset of participants who successfully completed the trial, the cessation rate was 42% in the micronutrient group compared to 23% in the placebo group (OR = 2.44). Notably, the effect of BSMs on cessation resembled the effectiveness of commonly prescribed medications for nicotine cessation, such as bupropion (odds ratio = 2.13) or varenicline (odds ratio = 2.88) (51). There were no notable differences in side effect occurrence between the micronutrient and placebo groups. The authors postulated that the underlying mechanism behind the positive impacts of BSMs on smoking cessation could potentially involve addressing neurobiological changes that stem from nicotine withdrawal and its associated neurochemical effects (e.g., nicotine's interaction with acetylcholine receptors and elevation of dopamine levels in the brain).

Additional clinical considerations

Numerous investigations have been conducted on the efficacy of various micronutrient formulations. However, two in particular, namely Daily Essential Nutrients and EMPowerPlus, have garnered significant attention due to their recurrent examination across diverse medical contexts, availability for purchase, favorable safety profile (52), and research from independent scientists. Utilizing these interventions in a clinical setting necessitates adequate training and education, as the BSMs have contraindications and interact with psychotropic medications (22, 23). The most common barriers for patients include the requirement for multiple pills per day (4–12 depending on age and formulation) and cost ($50–150/month), as well as lack of insurance coverage.

Discussion

Despite the availability of an expansive array of pharmacotherapeutic and psychotherapeutic treatment options, it is concerning that the prevalence of anxiety and depression is increasing.

This challenge offers the field of psychiatry a unique vantage point to investigate latent etiological factors that remain unaddressed. Within this context, the notion of nutritional insufficiencies as potential catalysts for the persistence or exacerbation of mental health disorders becomes a salient point of inquiry. Consequently, nutritional-based interventions are a pertinent avenue for exploration.

The phenomenon of irritability and emotional dysregulation is pervasive across various DSM-5 diagnostic categories and holds transdiagnostic relevance. Particularly within pediatric populations, antipsychotic medications represent the only treatment with strong support for the treatment of irritability,

and this is specifically when irritability is presenting as a core feature of autism spectrum disorder (ASD) (53). However, antipsychotic medications have substantial endocrine, metabolic, and neurologic side effects. There is a large gap and need for further treatments to address pediatric irritability (54).

There is considerable evidence that BSMs can improve emotional regulation, irritability, and global functioning with ADHD being the psychiatric diagnosis most studied. There is some evidence that they can also improve measures of anxiety and stress, both as a function of a mental illness and as a reaction to a traumatic event.

In light of the pressing imperative for nonpharmacological alternatives in addressing pediatric mental health, there exists a compelling rationale for the further investigation and clinical attention for the use of BSMs.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Author contributions

AV: Data curation, Writing – original draft, Writing – review & editing, Conceptualization, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation. MC: Data curation, Writing – original draft, Writing – review & editing. NR: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Meaning making and fostering radical hope: applying positive psychology to eco-anxiety research in youth

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The consequences of human activity on climate change are increasingly apparent. For example, they are causing ecological degradation and affecting human and animal health. Rightly so, it is considered as the most important challenge of this century. Researchers in psychology and mental health developed an interest in the direct and indirect effects of climate and ecological change on people's psychological wellbeing, which is referred to as a concept described as eco-anxiety or eco-distress. It is worth emphasizing that climate issues are taking a larger place in the school curriculum for youth in elementary, middle and high schools. Youth are thus increasingly aware of the major threat and understandably report legitimate concerns and worries. For some youth, eco-anxiety leads to greater involvement and activism, as can be seen by the international movement set out and led by youth activist Greta Thunberg. However, eco-anxiety can also lead to feelings of hopelessness and disengagement. Despite contributing the least to the climate and ecological crises, youth will be most affected by the impacts, and will carry the burden of the climate crisis throughout their lives. Researchers, educators and mental health professionals must therefore find ways to foster youth psychosocial wellbeing and resilience alongside ensuring that their voices are heard. To this end, it is vital that young people feel able to openly discuss climate change and associated issues alongside the distressing thoughts and feelings they engender. This can be supported by using various psychological approaches to develop effective interventions. Researchers and clinicians in child mental health could gain from drawing from research in positive psychology to develop such interventions. In this review and commentary, we will outline how eco-anxiety and child psychological wellbeing can be framed within a positive psychology framework, including the relevance of self-determined motivation. Insights from interventions based on positive psychology including exercises to foster hope, forgiveness and meaning making will also be discussed. We will highlight how such interventions can be adapted as powerful tools to foster child wellbeing and cope with their eco-anxiety.

KEYWORDS

eco-anxiety, child mental health, positive psychology, hope, self-determined motivation, meaning making, awe, coping

Overview

The consequences of human activity on climate change are increasingly apparent. For example, they are causing ecological degradation and affecting human and animal health (1). Rightly so, it is considered the most important challenge of this century (2). Researchers in psychology and mental health have developed an interest in the direct and indirect effects of climate and ecological change on people's psychological wellbeing, which is referred to as eco-anxiety or eco-distress (3). Recent incidents like the severe flooding in Europe and in China or extreme heat waves and vast forest fires across Canada and the United States (namely Hawaii) in the summer of 2023 have shed light on how climate change is increasingly affecting the daily life of those who, until recently, had been largely spared from such events. Despite clear warnings from climate scientists demanding an urgent, global response, governments and powerful organizations and corporations around the world are failing to act in line with the scientific consensus, which may be regarded to be moral failure (4). Noteworthy, recent conceptualizations of eco-anxiety suggest that moral injury through the failures of the people in power to act appropriately contribute substantially to causes of environmental distress, even more so than the awareness of the decline of natural environments (4–6).

The climate and ecological emergencies are taking a larger place in the mainstream media and in the collective consciousness (7, 8), as well as in the school curriculum for youth in elementary, middle and high schools (9, 10). Youth are thus increasingly aware of these significant issues and understandably report preoccupations about climate change and environmental issues (11, 12). For some youth, eco-anxiety leads to greater involvement and activism, as can be seen by the international movement set out and led by youth activist Greta Thunberg (13). Thunberg's activism has highlighted the growing involvement of today's youth, demanding accountability and action for climate change, including in courts of justice. However, eco-anxiety can also lead to feelings of hopelessness and disengagement (14). Despite contributing the least to the climate and ecological crises, youth will be most affected by the impacts, and will carry the burden of the climate crisis throughout their lives (11), yet they lack the political or economic power of adults to demand or effect the urgent societal changes required to minimise the worst outcomes. Researchers must therefore find ways to foster youth psychosocial wellbeing alongside ensuring that their voices are heard (15–18). Indeed, youth are active players who can push governments and other powerful bodies to act; for example, supporting them to put pressure on companies to take accountability or helping them to examine personal and community choices around issues such as consumption. To this end, it is vital that young people feel able to openly discuss climate change and associated issues alongside the distressing thoughts and feelings it engenders, and to recognise that this is a healthy, important, and valuable response. This can be supported by harnessing valuable insight from various psychological approaches to develop effective interventions. We believe that by developing such interventions, researchers and clinicians in child mental health would gain from drawing from research in positive psychology. Furthermore, such interventions would also improve our understanding about how young people experience eco-anxiety and how this interacts with psychological wellbeing.

In this review and commentary, we will outline how eco-anxiety and child psychological wellbeing can be framed within a positive psychology framework, including the relevance of self-determined motivation. Insights from interventions based on positive psychology (philosophy for children, photovoice, art-based interventions), introducing exercises to foster hope, forgiveness and meaning making will also be discussed. We will highlight how such interventions can be adapted as powerful tools to foster child wellbeing in the context of eco-anxiety in the climate crisis. As such, this paper is of interest to researchers, educators and mental health professionals interested in the psychological impacts of climate change and eco-anxiety in youth. This paper addresses how positive psychology may help in understanding such impacts and tools that are available to mitigate them.

Eco-anxiety and eco-distress

Eco-anxiety refers to the emotional, cognitive and physical changes an individual experiences when realizing the impacts of human action on the climate and the environment (3). It can also encompass broader issues such as how the climate crisis intersects with social inequality and global injustice. Eco-anxiety can involve numerous painful emotions, such as anger, sadness, guilt, hopelessness, and despair, and distressing thoughts about realistic, negative future outcomes or failure of humanity to respond with care to the challenges of our time, as well as a feeling of urgency to act and to improve the fate of the planet (3).

This broad spectrum of thoughts and feelings, that extend far beyond anxiety, has led to the more general label of "eco-distress". In this manuscript, we have opted to use the term "eco-anxiety" here as it is a term often favored by young people (19). We emphasise that eco-anxiety is not pathological, and may at times even be constructive, for example when it serves as a motivator of change, leads to higher civic engagement and decreases the negative impact on the environment (3, 20, 21). However, we also recognize that for some individuals, eco-anxiety can sometimes also involve an intense mix of emotions that may increase the level of distress, which may feel overwhelming and be very difficult to manage. In such cases, eco-anxiety may for example be characterized by a high level of preoccupation or catastrophic thoughts about the environment, and less helpful outcomes such as action paralysis (11, 22), social withdrawal, and decreased mental wellbeing (23).

Youth may be especially vulnerable to the distress provoked by eco-anxiety. Indeed, in a study by Strife (24), 82% of the sample of children aged 10 and 11 years-old from Colorado, USA, expressed preoccupations with the environment that caused them sadness, anger or fear. As such, although this topic has only recently started to be researched with youth, it appears that they do

indeed show signs of eco-anxiety (11). Some elementary school children have expressed worry, fear, and despair with regard to climate change, whether or not they have been directly impacted by events linked to climate change (25). They also have expressed similar emotions when thinking about their perception of the future, which includes destruction and negative changes in the environment. Past research has also indicated that youth's eco-anxiety may also come as a result of a higher connection to nature (26).

Research has also shown that some parents tend to avoid talking about climate change with their children, as they, wrongfully so, think their children are not preoccupied by this topic (27), while other parents may avoid discussing this with their children, thinking the discussion may generate anxiety. Either way, the resulting silence around the issue is similar, and a recent global survey of 10,000 youth found that 48% of those who had tried to talk about climate change with others had been dismissed or ignored (4). In school, some children openly express the need to talk about climate change (27). The emerging literature on this topic highlights the need to create safe spaces to acknowledge and talk openly about climate change and eco-anxiety with youth (28, 29). This could address their preoccupations, while providing the tools that allows them to understand and even adapt to painful emotions related to the climate crisis (e.g., by acquiring distress tolerance skills such as those taught within dialectical behavior therapy; 30, 31), which in turn could then permit them to explore new ways of responding, for example by fostering their civic engagement. As such, we posit that developing clinical approaches grounded in positive psychology can represent a promising way to respond helpfully to youth experiencing eco-anxiety. Specifically, it can provide an opportunity for meaning making and living a life that is in line with one's values (i.e., living a self-determined life), while also supporting and being supported by community development and civic responsibilities (32, 33).

Positive psychology

Positive psychology is the study of "what makes life most worth living. […] It is a call for psychological science and practice to be as concerned with strengths as with weaknesses, as well as being interested in building the best things in life as in repairing the worse" (34). Positive psychology strives to make life fulfilling, in addition to healing pathology. As such, positive psychology encompasses the study of variables pertaining to flourishing, such as happiness, meaning/purpose and wellbeing. Within a positive psychology framework, to foster flourishing in individuals, we must encourage the development of agreeable emotions (e.g., joy, love, satisfaction), alongside a sense of engagement and meaning making (35). With the emergence of the second wave of positive psychology, emphasis shifted to considering both positive as well as negative experiences—including, but not limited to mortality/death, suffering and distress—and how these interactions can lead individuals to transformation and personal growth (36, 37). We posit that the experience of eco-anxiety may serve as a good example of how a distressing emotional experience can lead to individual flourishing, namely through radical hope and meaning making, which are discussed below. The term "eco-anxiety" may suggest pathology, and so it may be appropriate to consider at times the alternative label "eco-distress" to be more aligned with the positive psychology approach (38). Indeed, ecological distress has been defined as "any forms of emotional, psychological, or existential distress related to present or anticipated ecological/climatic change", which is synonymous to eco-anxiety (35, p.1). However, we also think it important to engage young people in this work, and the term eco-anxiety for some may be more accessible and understandable. Either way, we posit that grounding the conceptualization and operationalization of eco-anxiety/eco-distress and the development of potential approaches with youth in positive psychology may provide a rich, more complete overview of the concept. It may notably help in illustrating the reality of growing up in today's world, characterized by social, economic, climatic, and ecological crises, all of which revolve around the theme of the environment. Positive psychology has the potential to offer youth new and effective ways of responding to the understandable distress that living in these modern times can elicit. Eco-anxiety is not considered a pathology (39) and can even be conceived as a healthy and desirable response to a genuinely distressing reality. Importantly, people who report distress, such as, for example, distress arising with eco-anxiety, can also report meaningfulness arising alongside it (40); for example the pain of eco-anxiety is often valued by the individual because it is an indicator of one's humanity, compassion and care (41). In line with this, broader psychological approaches recognize that living a life devoid of unpleasant emotions and stress is impossible. Indeed, when considering how one reacts to the climate crisis, flourishing and wellbeing in the face of challenge lies in how one responds to such challenges. Learning helpful ways of perceiving and responding to difficult emotions is what ultimately can reduce negative impacts on mental health and the development of psychopathology (42). For example, being exposed to mindfulness-based stress reduction meditations or to cognitive-behavioral approaches to challenge catastrophizing thoughts about the climate crisis could help youth to acquire stress management skills (30). Researchers in positive psychology have also called for a more inclusive way of studying both protective and risk factors together in mental health research, in youth and in adults (42). For example, eco-anxiety can create distress, while having positive impacts on one's wellbeing and resilience. Indeed, it fosters an alignment of action with deeper values, through civic engagement, in-depth reflections about one's place in the world and the role one has in preventing negative impacts of the climate and ecological crises (43). Finally, many researchers who have published on eco-anxiety in the past have been incorporating elements of positive psychology in their work without explicitly identifying it as such. Ojala's (44) work on coping mechanisms in children with regards to the climate crisis provides a good example of this. In this manuscript, we aim to bring together findings more explicitly from both positive psychology and the literature on climate anxiety to demonstrate

the value of considering these domains together to facilitate the development of effective intervention strategies for youth experiencing eco-anxiety.

Psychological—or eudaimonic—wellbeing is a concept that differs from subjective wellbeing (also referred to as happiness), as it encompasses a broader range of emotions and touches on the importance of "…living a meaningful, self-realized and fully functional life" (45, 46). As such, constructs including the satisfaction of basic psychological needs (47, 48), namely the need for self-determination/autonomy (living in accordance with one's values and interests), affiliation (loving others and being loved by others), and competence (having a sense of mastery on one's environment), as well as constructs such as morality, altruism, compassion and gratitude are considered as predictors of psychological wellbeing (49). Furthermore, forgiveness, which is also widely studied in positive psychology, is included within the larger concept of psychological wellbeing (50). Our previous research found that some children experience anger and resentment towards previous generations that have caused climate change (27). Moral outrage, anger and the related feelings of injustice have also been identified as valid reactions in the face of the climate, fueling citizens, including youth, to take action (51, 52). No one individual is responsible for the acceleration of the environmental crisis, so these emotions may be particularly difficult to process, understand and express. Nonetheless, each individual carries their own responsibility (53). As the youth of today shoulder the burden of climate change caused by past generations, the science of forgiveness may be especially useful to keep in mind as we operationalize eco-anxiety and develop clinical interventions exploring concepts that pertain to the forgiveness of past generations. However, a detailed review of the research on forgiveness is beyond the scope of this paper.

When considering determinants of optimal functioning such as wellbeing, resilience, and psychosocial adaptation, it seems clear that the science of eco-anxiety would gain to incorporate positive psychology more explicitly as the field evolves. Similarly, self-determined motivation is also relevant, as it encompasses an essential condition for the wellbeing of youth. Indeed, acting in a self-determined (or autonomous) manner has been previously linked to optimal psychosocial adaptation (47).

Self-determined motivation

With regard to climate change, emerging research with youth has recently evaluated whether *how* we talk about climate change with youth influences the integration of more eco-responsible behaviours and their overall wellbeing (54). Specifically, the importance of fostering self-determined motivation and the satisfaction of the basic psychological need for self-determination (also called autonomy; 47), appears particularly relevant to promote wellbeing in youth in relation to the climate crisis. Self-determination can be defined as acting willingly and coherently with one's values and what one deems as important (47). Whether youth's need for self-determination in pro-environmental behaviors (e.g., advocating, implementing strategies) is supported or thwarted may have a significant impact on their eco-anxiety levels. Anchored within self-determination theory (SDT), decades of research have shown that supporting autonomy and self-determined motivation are positively correlated with wellbeing, healthy motivation, mental health, school perseverance and academic success in youth (47, 55). Thus, in exploring the social conditions that are essential for fostering youth's wellbeing, much research has shown that the basic, psychological need for self-determination must be supported to foster children's psychosocial adaptation (32, 33). Significant people in youth's lives (e.g., parents, teachers, coaches, friends, therapists) can help satisfy or frustrate this need. Interventions that satisfy the need for self-determination further facilitate greater civic engagement and overall wellbeing in youth (32, 33).

Based on the existing research that highlights the benefits of autonomy support (56–62), it is likely important that interventions for eco-anxiety also support autonomy. As such, interventions that foster introspection and careful thought about moral issues and personal values could increase the satisfaction of the basic psychological need for self-determination, improve wellbeing and foster a greater desire for civic engagement in youth. Past research in the context of environmental education has also suggested that teachers, educators and significant adults should aim to encourage self-determined motivation to adopt proenvironmental behaviours, as these have been shown to be positively correlated, i.e., that the more one has internalized the motivation to take care of the environment, the more one gets involved in such behaviours (63). Teacher support in developing such a self-determined motivation has been shown to positively lead to youth adopting proenvironmental behaviors (64, 65). Similarly, contexts in which youth experience awe, which involves a component of self-transcendence and shifting of one's focus towards the greater good, could also foster introspection and reflections about one's core values, thus eliciting similar benefits as autonomy-supportive interventions.

Awe

Awe can be defined as "[…an] often-positive feeling of being in the presence of something vast that transcends our understanding of the world" (66). Amongst the domains that have traditionally been identified as conducive to experiencing awe, contact with nature has been frequently cited (67, 68). Unsurprisingly, experiencing awe has been positively linked with one's connectedness with nature and, in turn, with greater wellbeing (68). However, recently, the traditional interpretations of the role of awe in nature are challenged by eco-anxiety and grief. Indeed, as we are faced with news about the destruction of natural environments, we are also faced with the disappearance of potentially awe-inducing landscapes (69).

Experiencing awe is characterized as a state of self-transcendence, during which a greater sense of community can be reported (70). Research on this topic has shown that awe is positively correlated with prosocial behaviours and ethical decision-making (71). As such, the shift in focus that is

experienced when one feels awe—from the self towards the greater good—may very well be useful in the context of discussing climate change and fostering civic engagement in youth. Indeed, Yang and colleagues (70) showed that adults experiencing awe were also more prone to adopting more eco-responsible behaviours, while connectedness to nature mediated this relationship. Yet, there remains a paucity of rigorous research establishing a link between self-transcendence, awe, and pro-environmental behaviours (72). Moreover, to our knowledge, to date, no such research has been conducted with youth. Given the preliminary evidence pointing to a link between feeling connected with nature, experiencing awe, and adopting pro-environmental behaviours, finding ways of incorporating contact with nature within clinical interventions to address eco-anxiety in youth may be of interest. A detailed discussion on nature therapy and outdoor education for youth is beyond the scope of this paper, although a recent systematic review has pointed more generally towards the positive influences of nature on youth mental health (73).

Furthermore, previous work on outdoor education has suggested that youth, just like adults, can develop emotional bonds when in contact with nature, and that these bonds can be used as leverage for social action (74). Indeed, youth who report a stronger connection to nature seem to engage in more pro-environmental behaviors and report greater concern about preserving the environment (75, 76). Conversely, youth who are more connected to nature also seem to experience more eco-anxiety and are more keenly aware of climate change (77). As such, a greater connection to nature can be linked both to increased wellbeing and distress, whether the focus of the research is on the climate crisis or not (26).

The importance of fostering hope

Hope can be conceptualized as a dynamic cognitive-emotional concept. More specifically, it can be described as a positive emotional state associated with a perceived confidence in the ability to achieve goals, along with the determination to pursue them (78). Hope has been linked to adaptive functioning, resilience and psychological well-being (79). As hope is a broad construct, with various subtypes, it is important to consider how these relate to people's experience of, and relationship to eco-anxiety. False hope can be conceptualised as a type of hope that is grounded in a denial or disillusion of reality or a biased confidence in the ability to achieve goals (80, 81). This can be seen in today's world, where the real threats to planetary health may be disavowed or denied, through false hopes, such as a belief that things will work out through technological fixes, or that things cannot be as bad as the scientific consensus demonstrates. Such false hope may, for example, be practiced by people who are not ready to grasp the complexity of the situation or who may feel too overwhelmed and lacking in the emotional tools to cope with the reality of the climate and ecological emergencies that concern them. This has been described as an important aspect of climate change awareness, where people may remain in a state of denial before moving to a place where they are ready to face the distressing reality with the appropriate coping tools (22). A helpful idea here is to consider models of grief and mourning, where denial is an important part of one's journey towards realization and acceptance of significant loss or change (82, 83). Children may be similar to adults in this way, as they may also use false hope to cope by downplaying the threats and losses posed by climate change or believing that the planet has not yet really been affected (27). This can include overly optimistic or simple messages about progress or unbalanced by information about our challenging reality. These, in fact, do not appear to benefit the individual (81). It is important to recognize this stage of denial of eco-anxiety, to ensure that children are not pushed out of unknowing or denial before they are also equipped with tools that help them experience the painful thoughts and feelings that come with engagement. This will include skills in emotional regulation (including, but not limited to, stress management and distress tolerance; 30), awareness of their values (hence linking back to self-determination), how this can translate into intention and action, and an ability to practice self-care. Indeed self-care can be a broad outcome of positive psychology interventions, which can be defined as "a multidimensional, multifaceted process of purposeful engagement in strategies that promote healthy functioning and enhance wellbeing" (84).

On the other end of the spectrum is radical hope. The term is rooted in the context of traumas that are present within individuals and communities, from cultural or historical injustice. Radical hope aims to find new ways for people and communities to transform in a way that heals old wounds and moves towards greater levels of psychological wellbeing (85). Radical hope speaks to our collective memory of the past, and the need for both collective and individual orientation towards making changes that are in service to societal health and self-determination (86). Radical hope is thus an act of courage as it involves turning towards the painful realities and devastation currently facing humanity without giving up, holding on to the belief that a better future is possible, perhaps attempting to imagine what this could be, and remaining determined to work towards it (87). As such, it fits nicely within positive psychology's second wave. Related terms in the literature include "realistic hope", "active hope", "constructive hope" which emphasise the importance of seeing the reality of the crises alongside active movement towards a better future (88).

Radical hope in the context of climate change requires us to consider new and possibly radical conceptions of the future (89). In the face of the overwhelming, uncertain and potentially catastrophic impacts of climate change, radical hope acknowledges the severity of the situation and this in turn supports our realisation that we need significant and meaningful transformations, and new ways of embedding sustainable living into our globally connected lives (90). Radical hope embraces uncertainty, recognising that although one cannot know where one's actions will lead, one remains committed to working towards a more sustainable and just world, in a way that is aligned to one's values. As such, it can also relate to the concept of autonomy support discussed above, as it implies a validating and empathic posture from significant adults in children's lives. These forms of hope challenge the status quo by allowing us to think of new stories about how the future might be, which can

be a creative act, allowing us to imagine new ways of seeing our relationship with the environment and each other (91). It can inspire individuals and communities to engage in meaningful pro-environmental actions, even in the face of immense uncertainty and adversity. Such an approach to hope is closely linked to meaning making and finding purpose (92).

In the context of climate change, some children have expressed hope in humanity, as they perceive that people are taking the issue seriously (27). Semi-structured interviews with children between the ages of 8 and 12 years old revealed that some retain a sense of hope for their future while acknowledging the uncertainty of the future (27). These forms of hope have been associated with action competence and feelings of agency and self-determination in youth (93, 94). Hope may be linked to well-being when empirically justified and allow for action that is rooted in meaning (94). As such, hope can be learned and fostered, through culture and age-specific strategies to allow individuals and communities to cope with climate change (95). One recent example of this is a school-based workshop in which children engage with both their eco-anxiety and their imagination to help them explore new ways of living in the future, engendering hope, motivation and confidence in talking to others about these difficult topics (19). Educators and researchers in education alike have also included notions of radical hope and fostering hope within the high school environmental education curriculum (96). Similar initiatives have also been implemented in elementary schools (97). Past research has highlighted the crucial role that teachers can have on children's environmental activism and desire to become involved in working against climate change (98). As such, teachers and parents can positively influence children's desire to act to safeguard the environment and adopt a radical hope posture (99). These important adult figures can also foster children's self-determined motivation to act. Furthermore, a recent review has highlighted the importance of collective action in supporting constructive hope, indicating the need for approaches in this area to develop a posture that supports this within groups and communities working together, rather than on an individual basis (81).

Coping with eco-anxiety

Coping can be understood as a process of adaptation and dealing with difficult or stressful life experiences (100). Coping is influenced by personal factors, past experiences, and the nature of the stress itself (101). The context of climate change presents itself as a difficult situation with much uncertainty, giving rise to many difficult emotions. As such, as children become aware of the climate crisis, they must learn to use various coping strategies to deal with these difficult emotions and sources of stress. More than one model of coping with eco-anxiety has been published in recent years (102). However, we choose to present work by Ojala (103) that has been conducted specifically with Swedish children. The coping model presented by Ojala is yet to be validated across various populations of children, but expands on the well validated coping models by Lazarus and Folkman (100). Building on this model, Ojala has suggested three types of coping approaches used by children: problem-focused, emotion-focused, and/or meaning-focused techniques (103). *Problem-focused coping* aims to reduce difficult emotions by acting individually or collectively to solve the issue. Although this may be empowering at times, it can also over-emphasise a sense of personal responsibility, which in turn may lead to guilt or burn-out, as these issues cannot be solved by individual action alone (104). Indeed, Ojala (44) found that this type of coping was correlated with more negative affect and lower life satisfaction. *Emotion-focused coping* aims to identify, tolerate and sometimes decrease difficult emotions, and the most common methods used by children involve distancing from the threat of the climate crisis by changing the subject, thinking of something else, seeking emotional support, or ignoring information about the issue (similar to false hope) (103). Unfortunately, according to Ojala (44), when this type of coping is employed to decrease difficult emotions, it only provides momentary relief, as the reality of the climate and environmental crises are increasingly obvious to children via media, school, and direct observations. *Meaning-focused coping* is suggested to be more adaptive in the long term, as this strategy involves acknowledging reality, including the complexity of the issues involved and how these go beyond the personal. It also recognises the agreeable emotions that may be present, including a sense of engagement, energy and inspiration that comes from wishing to act in response to the climate crisis. This can enable youth to reframe eco-anxiety in a more helpful and constructive way. Beneficial aspects of meaning-focused coping include identifying important values, hopes, beliefs and self-identities and how these may be called upon to respond to the crises. Youth may then be able to reappraise the situation as one that has also the potential for growth and community engagement. This research indicates the importance of supporting youth to develop meaning-focused coping strategies where they can experience the full range of emotions (both difficult and comfortable) related to climate change, alongside making meaning out of the situations we are all confronted with. This aligns with the concept of eudaimonia in positive psychology which emphasises self-actualisation and the search for meaning in life (105). This sense of meaning has been argued to be associated with psychological wellbeing (105).

Fostering meaning making: suggestions for developing clinical interventions to address eco-anxiety in children

There are many existing approaches within the literature known to improve mental health and wellbeing in children and young people through positive psychological approaches, some of which have been highlighted above. Here we examine three approaches among many others that could be adapted for youth who are reporting eco-anxiety, due to their ability to engage with issues such as self-determination, meaning-making, constructive hope and collective sharing and engagement.

Indeed, just like adults, children seek to attribute meaning to their life and to the world that surrounds them (106). Implementing interventions focused on meaning making in the context of climate change and eco-anxiety could positively impact wellbeing in children, by offering a safe space in which to question their beliefs and values pertaining to climate change. This section presents different interventions that could be helpful in this regard.

Philosophy for children (P4C) and existential psychology

Philosophy for children (P4C), a pedagogical approach that promotes critical thinking, caring, creative reasoning and inquiry in schools, is a good example of an intervention that can promote meaning making. Moreover, although it was not initially developed with the aim of having an impact on children's mental health, P4C has been shown to improve children's mental health (107, 108). By fostering greater resiliency and self-determined motivation in children, P4C (and other similar interventions) could also promote greater engagement about the climate crisis and perhaps reduce distressing levels of eco-anxiety for some children.

Interventions incorporating P4C could also promote better knowledge of one's own self-determination, which, in return, would most likely lead to improved wellbeing (109–111). P4C also has the potential to help children reflect on existential questions, such as those generated by climate change (112). As experience of eco-anxiety is deeply rooted in existential threats to one's identity, happiness, meaning, death, freedom and isolation (69), this suggests the importance for children to discuss, explore and think critically about these topics, while being adequately supported by significant adults, such as parents or teachers. Previous work on eco-existential psychology has also shown that contact with nature can help to address these existential threats (113). Indeed, as children and adults are confronted with the death of nature and the subsequent eco-anxiety it may generate, authors have suggested that being immersed in nature may help with gaining better knowledge of one's self-concept. This may help address existential threats that are provoked by climate change and foster meaning in life, namely through coherence with one's values (i.e., self-determined motivation) and overall purpose, appropriate to their developmental level (114). Furthermore, previous work on P4C and mental health brings us to conclude that when children are faced with existential questions, supporting them in reflecting and developing critical thinking skills about these questions improves their wellbeing and self-determination (107, 108).

Photovoice

Photovoice is another promising intervention focused on meaning making that could be implemented with children. It has been used as a therapeutic approach that encourages civic responsibility, citizen action and engagement and global social changes (115). Photovoice is considered to be a form of art therapy (116), encouraging individual expression through picture taking and fostering autonomy support. Participants discuss in a group their respective pictures in a group setting, which promotes spoken expression, collective dialogue, and discussions of community issues. The overarching goal of photovoice is to make sense, collectively, of a given issue (117). In this regard, it has similar aims to P4C described above. With youth, photovoice has been used to foster engagement and citizen participation, the development of critical thinking and moral judgement, as well as social identity (118). Photovoice has also been identified as an promising intervention to promote knowledge mobilization and bridge a gap, as art exhibits organized around youth's pictures can allow young participants to be heard by politicians and policy makers (119).

As such, using photovoice or facilitating discussions and reflections about climate change and eco-anxiety in schools can support the need for conceiving and approaching eco-anxiety through a positive psychology lens. In positive psychology, involvement in the community, having a feeling of belonging and of being an important member of one's community are crucial aspects of positive—or enabling—institutions (34). Enabling institutions are those that "…contribute to the fulfillment of the individuals within it. […] fulfillment must reflect effort, the willful choice and pursuit over time of morally praiseworthy activities" (34). Elementary schools can be enabling institutions when their students are taught to be active members of their community, caring of others and responsible individuals. Students themselves report being more self-determined when they attend schools that adopt an enabling posture (120). It thus appears relevant to implement interventions that are geared towards fostering student wellbeing while also facilitating elementary schools to be enabling institutions.

The society in which a child grows up can also be considered an enabling institution (34). As such, a "good society" is defined as one that aims for the psychological wellbeing of the highest number of people. The threat of climate change, our individual responsibility in safeguarding the planet and the wellbeing of the next generations thus could fit within the concept of the good society as an enabling institution. Photovoice can contribute to this goal, since it promotes and sustains relationships between the research community and the general public (121). Furthermore, photovoice can be a very powerful and self-determined way for children (and adults) to illustrate and talk about their concerns.

Recently, photovoice has been used in research with the specific aims of discussing climate change and eco-anxiety, in youth and adults alike (122–124). Studies using photovoice have shown the pervasive impacts of climate change upon the wellbeing of adults following direct experiences of environmental catastrophes (122), while documenting resiliency and community action in farmers being impacted by the climate crisis (123). With youth more specifically, photovoice has also been useful to engage them, in a developmentally appropriate way, in discussions about the environment, sustainability and the conservation of nature in their community (121). A recent study has also shown how photovoice can be used with children to help them learn about and understand climate change, specifically how climate change was linked to their daily lives (125). Group discussions pertaining to the children's pictures were also conducive to expressing concern for how climate change affected people

around them (e.g., members from their family). Finally, it is worth noting that photovoice can also be used as a pedagogical tool in environmental education with children, as it can provide them with an opportunity to voice their thoughts and feelings about climate change in a context where they often report the feeling of not being heard, thus supporting their autonomy (124).

Other art-based interventions

Although art therapy was initially developed within the psychodynamic framework, recent publications on this topic have shown varied influences, namely from cognitive-behavioural therapy and social-emotional learning (126, 127). Positive art therapy has also been explored and developed in recent years (128). With children, previous research has shown that art-based interventions facilitate expression, discussion and awareness of one's emotions (129). This, in turn, can foster self-determination, which also promotes better emotional and social adjustment (130). Art therapy with children, especially when rooted in positive psychology, can also improve wellbeing, quality of life and foster self-determination, namely by helping children gain a sense of control in situations where they feel they do not have control (131–133). Given the perception of lack of control is central to the experience of eco-anxiety, one can stipulate that using art to discuss and explore climate change and eco-anxiety could have similar effects in children. Being in contact with the arts (fine arts, dance, literature, and music alike) has also been consistently associated with awe-eliciting contexts (42). Nonetheless, to our knowledge, little is known on whether art therapy could be helpful in the context of eco-anxiety in children. Further research is thus needed to evaluate this hypothesis.

Finally, a recent scoping review of interventions to address eco-anxiety identified creative expression as one of the main themes with the potential impact to help individuals foster a greater sense of community (134). Engaging children in drawing elements of nature they appreciate has been suggested as potential transformative experiences that stimulate attachment to nature and subsequent environmental activism (98). Art therapy stimulates creativity, which is a flagship character strength to nurture in positive psychology. Creativity has been positively and consistently linked to wellbeing in the scientific literature (135); individuals who are more creative tend to report higher wellbeing and vice-versa. Engaging in art creation has also been associated with a greater sense of purpose and competence in older adults (136). Further, engaging in creative writing exercises (137) and taking part in theatre [or drama education; (138)] to discuss eco-anxiety has been implemented with adults and youth alike, although we have yet to see published results of the impact of such activities on their wellbeing and eco-anxiety.

Conclusion

The purpose of this article was to explicitly articulate how positive psychology can inform the burgeoning research on eco-anxiety and youth. Specifically, notions pertaining to self-determined motivation, awe and hope establish some theoretical bases on which researchers, educators and clinicians can build upon to develop interventions targeted at exploring eco-anxiety in children, fostering hope and civic engagement. Interventions using philosophy for children and the arts show promise in this regard. As we conclude, we wish to reiterate that eco-anxiety is not pathological; the point is thus not to make it go away but to make sure it is not destructive in children. We thus aim to reduce its impact on mental health and wellbeing children, and to help them see the meaning in it. We also wish to recognize that part of the feeling of eco-anxiety is directed towards failure of those in power, which is caused by adults. As such, any "cure" for eco-anxiety in children lies in changing our cultural approach to caring for the planet, not in young people themselves. By taking such an approach and helping youth, we will also foster the mental health of those who will become actively involved in acting towards a better future.

However, this line of research also represents an opportunity, since by supporting children with such distress, we can reimagine what supportive emotional and environmental education should entail. Part of this includes seeing our values and learning how to respond to difficult emotions, rather than trying to avoid them or make them go away. It also implies developing sources of agreeable emotions (e.g., awe, sense of community, etc.) and decreasing thoughts based on consumption. Finally, research on autonomy support and self-determined motivation highlights the importance of adults hearing and heeding young people, not dismissing, and ignoring them. By supporting youth in developing said self-determined motivation, we can foster their wellbeing and perhaps reduce the negative impact of eco-anxiety, while supporting them to be well heard by those in power.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Comparing the effectiveness of narrative therapy and EMDR-GTEP protocols in the treatment of post-traumatic stress in children exposed to humanitarian crises

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Background: The mental health of children living in humanitarian crisis situations is a major issue. Post-traumatic stress disorder (PTSD) causes great psychological suffering and has negative consequences on children's development. The aim of the study was to analyze retrospective data collected in a mental health and psychosocial support program for children in the Central African Republic, and to compare results of two trauma-focused treatment interventions: the narrative protocol Action contre la Faim (ACF)/KONO; and the EMDR-based Group Trauma Episode Protocol (G-TEP). Both protocols are proposed in a group setting and led by paraprofessionals.
Methods: In the program, 884 children attended a psychoeducation session and after that, 661 children (290 for ACF/KONO and 371 for G-TEP) benefited from all treatment sessions. PTSD was measured by the Children's Revised Impact of Event Scale (CRIES-8). General distress was measured by the Child Psychosocial Distress Screener (CPDS). Data were collected before and after treatment, and measured 5 months after the end of treatment for 185 children.
Results: Participants in the ACF/KONO group show a significant reduction on CRIES-8 ($t = 44.8$; $p < 0.001$, effect size = 2.63) and CPDS ($t = 38.2$; $p < 0.001$, effect size = 2.24). Participants to the G-TEP protocol show a significant effect with reduced scores on the CRIES-8 ($t = 49.2$; $p < 0.001$, effect size = 2.55) and CPDS ($t = 57.2$; $p < 0.001$, effect size = 2.97). A Student's t-test comparing the ACF/KONO and G-TEP groups shows no significant difference between the two types of treatment between pre- and post-treatment CRIES-8 scores ($t = 1.744$; $p = 0.514$, effect size = 0.040) and CPDS scores ($t = 1.688$; $p = 0.092$, effect size = 0.323). An analysis of the follow-up data for the 185 children shows that the effects of both protocols are maintained over time with mean scores after treatment and follow-up below the clinical cut-off for both CPDS (<8) and CRIES-8 (<17).
Conclusions: Both protocols have been shown to be effective in reducing traumatic symptoms in children exposed to conflict; they can be conducted by paraprofessionals and used in humanitarian crisis situations.

KEYWORDS

PTSD, children, paraprofessional, EMDR, G-TEP, CBT, TF-CBT

Introduction

More than 1 in 6 children and adolescents worldwide (468 million in total) live in areas affected by armed conflict (1). In these contexts, children are exposed to all kinds of violence, abuse, exploitation, and neglect; they may die or be injured, experience malnutrition and other illnesses, lose or be separated from their families and loved ones, and have poor access to basic services. These factors have a major impact on their survival, growth, and development (2, 3). It is estimated that approximately 10%–20% of children worldwide experience mental disorders (4–6). In war, these disorders are more common and include post-traumatic stress disorder (PTSD) and post-traumatic stress symptoms, behavioral and emotional symptoms, sleep problems, disturbed play, and psychosomatic symptoms, anxiety disorders, and depression (7–10). The effects on mental health depend on the child's age, caregivers' emotional situation and their capacity to take care, daily safety, and protection (10, 11). PTSD has devastating consequences for children, alters the architecture of their brain (12), and puts their development at risk, as well as their ability to concentrate, keep up with schooling, and build appropriate and ongoing social and emotional relationships. Recognition, prevention, and treatment of PTSD in conflict zones are still largely inadequate (13–15). Data on psychological interventions for children in war situations are few and of insufficient quality to demonstrate a beneficial effect of therapies on the reduction of PTSD symptoms (16). This public health problem needs to be addressed for children so that they can enjoy a psycho-emotionally healthy future. Internationally, the recommended treatments for PTSD are Cognitive Behavioral Therapy (CBT) and Eye Movement Desensitization and Reprocessing (EMDR) (17–21). CBT is a form of brief therapy that aims to modify negative thoughts, emotions, and reactions. Adapted to the treatment of trauma, trauma-focused CBT (TF-CBT) includes psychoeducation, exposure to traumatic memories, and cognitive reprocessing on the symptoms and effects of PTSD. EMDR is a therapy developed by Francine Shapiro (22–24), based on the Adaptative Information Processing (AIP) model. The therapy is in eight phases and includes bilateral stimulation, and aims to facilitate access, process traumatic memories or adverse experiences (25) to bring an adaptative resolution. Studies comparing CBT and EMDR with children and adolescents show no difference in terms of efficacy (26–28) or a better efficacy of EMDR (29) but with a too limited number of EMDR studies. This explains why recommendations focus first on CBT and then on EMDR if CBT does not work (30, 31). These two therapies are often proposed in an individual setting and conducted by psychologists after extensive training. In most emergencies, there are no, or not enough, trained specialized professionals. Task shifting might be an option to scale up access to mental healthcare in addition to brief intervention protocols (32–36), even if more research is required to evaluate their effectiveness (37–39). Therefore, it is important to evaluate the effectiveness of brief (1) intervention protocols (2) in groups, to treat PTSD in children (3) in emergencies and (4) in countries where the number of mental health professionals is very low and to demonstrate that treatments for PTSD in children do exist, are feasible in emergency contexts, and that they allow for wide coverage since they are part of a public health approach.

The Central African Republic (CAR) is an example of emergency context, where mental health and psychosocial problems are high but with a limited capacity in mental health professionals. A decade after the military-political crisis of 2013, CAR has yet to benefit from peace and sustainable development. According to the annual report of the United Nations Office for the Coordination of Humanitarian Affairs (40), almost 265,000 people have been directly affected by conflict-related shocks. The north-western regions (Ouham, Ouham-Pendé) recorded the highest number of people affected, representing 45% of the population affected by violence. Documented violations include summary executions, rape, torture and cruel, inhuman, and degrading treatment, arbitrary arrest and detention, kidnapping, destruction or looting of property, and the recruitment and use of children by national forces and armed groups. Some civilians were targeted because of their ethnicity or religion.

The Humanitarian Needs Overview (HNO 2022) (40) reveals that children have been subjected to physical or psychological violence during forced displacement and that, because of these incidents, traumatized children have lost their zest for life as well as their sleep. Nationally, almost one in two households (44%) has at least one child who has shown symptoms of a mental disorder in the last 2 weeks, particularly sleep disturbances, sadness, loss of appetite, and unexplained tiredness. This feeling of distress is more prevalent among children living in the high-violence areas of the north-western, central, and south-eastern prefectures. The psychological and social consequences of the crisis in CAR are serious and risk compromising the mental health and psychosocial wellbeing of children and adolescents in the long term. The HNO 2022 reports changes in children's behavior since 2021. The most frequently cited are negative coping behaviors, such as aggression (61%), refusal to go to school (54%), violence against young children (41%), and an increase in high-risk sexual behavior. Children and adolescents affected by the conflict need appropriate psychological support to help them regain a sense of security and give them the opportunity to overcome traumatic experiences and develop skills to cope with future crises, regulate their emotions, and establish and maintain positive relationships (41). However, resources dedicated to mental health are scarce and insufficient to fill the considerable gaps that exist in CAR (42). The psychiatric hospital in Bangui remains the only specialized structure offering mental healthcare. In terms of governance, a national mental health policy was drawn up in 2011, but it is experiencing implementation difficulties. This has led to an extremely limited mental health support capacity at national level.

In this context, the non-governmental organization Action contre la Faim (ACF) has been running mental health and psychosocial support programs in CAR since 2008. These projects offer psychosocial support to people in distress, including children. In particular, during 2016, children aged 6–17 years, who had been directly exposed to potentially traumatic

events, took part in group psychological treatment according to the narrative protocol: ACF/KONO (43). The aim of this psychological support was to strengthen individual and collective resilience to cope with new living conditions, guarantee psychosocial wellbeing, and support children's healthy development, reducing symptoms of post-traumatic stress.

This protocol has been shown to be effective in reducing traumatic symptoms and psychic distress in children, although it has a number of limitations that may limit its use in emergency contexts. The protocol consists of five sessions. However, in conflict and highly insecure situations, it is not always possible to guarantee this continuity of care, either because the teams and/or participants cannot return to the sites because it is too dangerous, or because the populations are displaced and flee or return to their homes. Another specific feature of the ACF/KONO protocol is that people are asked to narrate their trauma and/or difficult events. This can be both a factor of cohesion and potential identification within the group as well as a point of support for overcoming traumas. On the other hand, it can sometimes make the process complicated, either because of the PTSD itself or because these events can lead to shame and limit sharing within the group. The final element concerns the risk of vicarious traumatization, as participants and teams hear each other's traumatic experiences. These factors led us to evaluate the feasibility and effectiveness of other intervention protocols for dealing with trauma.

As part of this type of project, the ACF team has decided, in 2022, to introduce a new approach based and adapted from EMDR therapy, which has proved effective in other contexts: the Group Trauma Episode Protocol (G-TEP) developed by Shapiro and Laub (44).

Before extending the use of this new protocol, it was fundamental to analyze the results by comparing them with the ACF/KONO protocol that had already demonstrated its effectiveness.

The overall objective of this study was to contribute to improving the management of symptoms of PTSD in CAR by comparing the results of two trauma-focused treatment interventions for children to assess the impact of therapeutic approaches adapted to trauma management in humanitarian contexts. In addition, the study also had the specific objective of assessing the maintenance of improvement in wellbeing and reduction in traumatic symptoms over time.

The results will make it possible to adapt trauma management protocols that have a positive impact on improving children's wellbeing, and to observe any differences between protocols to make better choices according to humanitarian situations and constraints.

Materials and methods

Participants

Inclusion criteria

The population participating in the program consisted of children exposed to traumatic events due to the ongoing conflict in the country. The program was carried out in the prefectures of Nana-Mambéré, Ouham, Ouham Pendé, and Mambéré Kadei. Children aged 6–17 years who had been exposed to traumatic events and had scores of 17 or more on the Children's Revised Impact of Event Scale (CRIES-8) were eligible for the study.

Exclusion criteria

Children with psychiatric disorders assessed by the ACF psychologist were excluded from the program and referred to specialized services for appropriate care. When the mental health specialists were not present in the area, advocacy was carried out with the Protection and Health Clusters and the mental health working group.

Procedure

Children were recruited in localities where the ACF team had been deployed after a critical incident. The methodology consisted of starting with a psychoeducation session on the normalization of traumatic symptoms organized within these communities. Children were free to attend this session. After this session, the presence of PTSD was assessed using the CRIES-8 for children willing to participate in the program. Children with scores of 17 or higher were included in the program if they wished and randomly assigned to the ACF/KONO or G-TEP therapeutic group.

In total, 884 children have participated in psychoeducation and 793 have been invited to take part in the program (Figure 1). A total of 402 children participated in the ACF/KONO protocol and 391 in the G-TEP protocol. The intervention consisted of five bi-weekly sessions for each protocol. Data were collected using a standardized questionnaire that included demographic data on the children (gender, age, etc.). Psychometric data were collected at three time points: at admission, at the end of treatment, and 5 months after the end of treatment. For security reasons, it was not possible to return to all the intervention areas. We were only able to carry out the follow-up in two areas and reach a sample of 185 children to repeat the psychometric scales and measure the effect of the two therapies over time.

The intervention followed the principles of the Declaration of Helsinki and international guidelines on ethics in clinical research (Council for International Organizations of Medical Sciences-CIOMS, 2009). Before the psychoeducation session, before data collection, parents and children were given full information about the program. Parents gave written informed consent for their child to participate. Participation was voluntary and children could withdraw at any time without giving any reason for their absence. The data collected were completely anonymous. The databases did not contain any elements that might allow participants to be identified. This is a normal procedure in emergency settings to protect the information of individuals and ensure confidentiality and their security.

The study consisted of a secondary analysis of anonymized data collected as part of routine monitoring and evaluation activities conducted by ACF for its programs in 2022. Given the

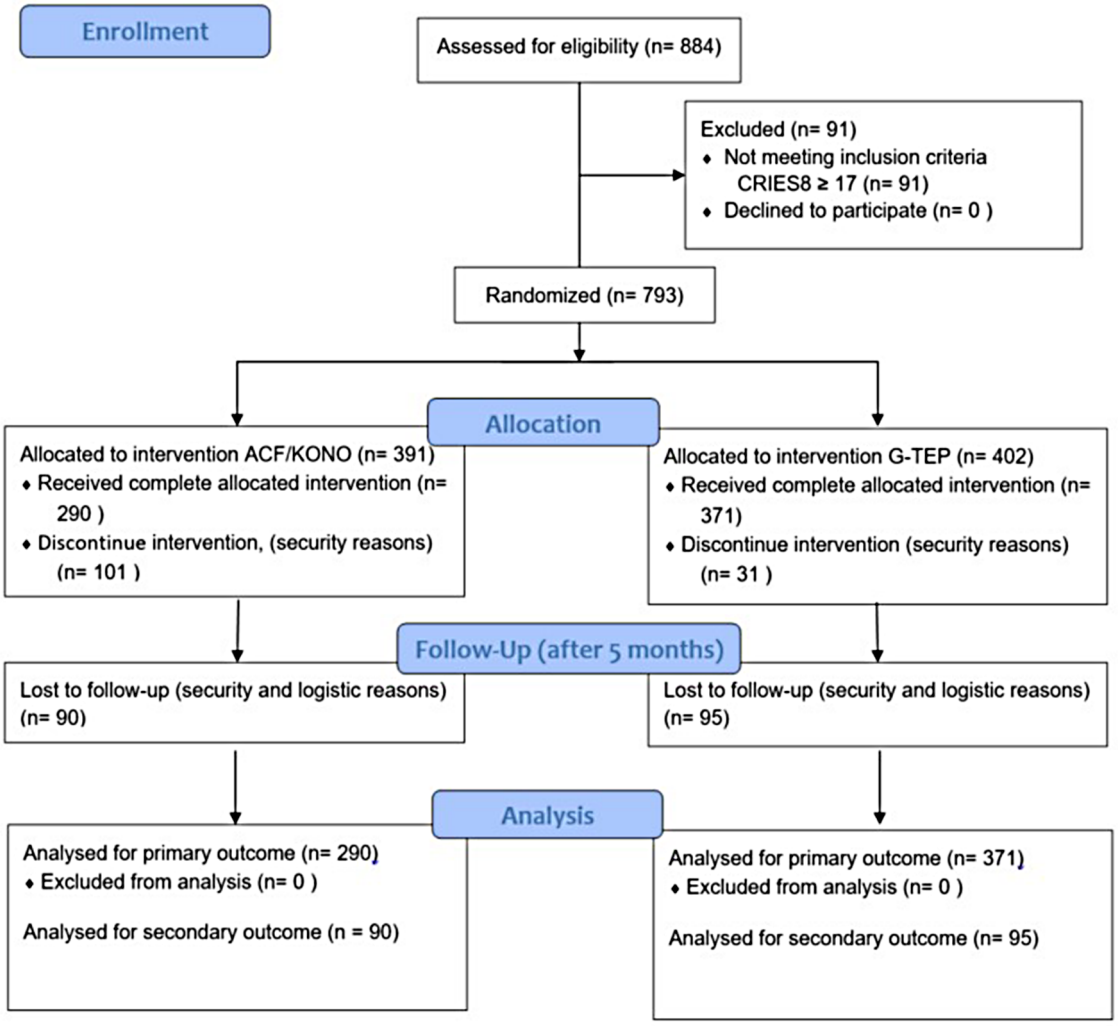

FIGURE 1
Program design and flow of participants.

exclusive use of de-identified secondary programmatic data, this study is not considered to be research involving human subjects, in accordance with the CNIL's Deliberation No. 2018-155 of 3 May 2018 approving the reference methodology relating to the processing of personal data implemented in the context of research not involving the human person, studies, and evaluations in the field of health (MR-004).

Protocol ACF/KONO

The trauma-focused narrative protocol "KONO" has been developed and implemented in several humanitarian contexts by Action Contre la Faim. A study in the Central African Republic validated its effectiveness on 674 children aged 6–16 years, showing a significant reduction in symptoms of trauma (43). The sessions last 90–120 min and a different theme is addressed each time (loss and bereavement, traumatic events, the future). The children are invited to share their fears, negative emotions, and resources, and to talk about what they have been through and how they imagine their future. The psychosocial worker accompanies the process, providing emotional support to the participants and helping them to tell their stories with the help of the group. The facilitator provides psychoeducation and relaxation and stress management techniques. Children are also invited to use drawings at each session (45).

Protocol G-TEP

The G-TEP, developed by Elan Shapiro (46), is a simplified adaptation of the recent traumatic event protocol (R-TEP) (44) for adults, children, and adolescents who have had recent or past traumatic experiences with effects in the present. It is a group-

based intervention for treating a traumatic episode to reduce traumatic stress, promote adaptive processing, strengthen resilience, and prevent post-traumatic complications (47). Each G-TEP session is the same, unlike the ACF/KONO protocol. The protocol includes connection to past, present, and future resources that can be shared in a group, exposure to traumatic memories and alternating bilateral stimulations. The effectiveness of G-TEP has been demonstrated after two sessions (48). G-TEP is used by mental health specialists who have been trained in EMDR, which greatly limits the possibility of deploying it on a large scale in low- and middle-income countries (LMICs) or in conflict zones where mental health professionals are rare and those trained in EMDR are even rarer. The G-TEP is a simplified, comprehensive protocol, based on a G-TEP sheet, filled in by the participant as the session progresses, with distancing via drawing, and which is implemented in a group setting. As such, it could offer an alternative to the "classic" EMDR protocol through the training and supervision of paraprofessionals by G-TEP-certified trainers. Recent research has shown the effectiveness of G-TEP used by paraprofessionals in reducing traumatic symptoms in adults in conflict settings (49).[1] The aim of this research was to verify the validity of the strategy for scaling up this EMDR-adapted protocol for children.

Profile and training of the team

The team consisted of 10 psychosocial workers, 2 supervisors, 1 project manager (expatriate clinical psychologist), and his deputy. The psychosocial workers and the supervisors were secondary school graduates with various university qualifications (law, health assistant, nursing assistant, management sciences, geography, social sciences technician, etc.), seven of whom had at least 3 years of experience in psychosocial and psychological support activities at ACF, the others between 18 months and 2 years. All had received training in psycho-trauma and the protocols used (G-TEP, ACF/KONO). They carried out the psychological treatment under the supervision of two supervisors who provided ongoing technical support in setting up the treatment groups. The Deputy Program Manager (who holds a master's degree in public law and has extensive experience in mental health and psychosocial support programs) was responsible for planning and organizing activities in the field. The clinical psychologist was responsible for the technical quality of the interventions, training the teams, and analyzing the quality of the data collected. The entire team was regularly supervised remotely and during field visits by a clinical psychologist trained in EMDR and the G-TEP group protocol.

[1]Dozio E, Bizouerne C, Lassalle N, Farrell D. Comparaison de protocoles de groupe EMDR et Thérapie Cognitivo-Comportementale (TCC) pour traiter les traumatismes en contexte humanitaire mis en place par des paraprofessionnels. (in press).

Measurements

Two scales were used in this program.

The CRIES-8 (50) is an eight-item scale used to screen children at high risk of PTSD. It is adapted by the Children and War Foundation from the Impact of Event Scale (51) that assesses subjective distress caused by traumatic events in adults. Items are rated on a 4-point scale (none = 0, rarely = 1, sometimes = 3, and a lot = 5), according to frequency over the past week, and in relation to a specific traumatic event. The total score is in the range of 0–40, with higher scores indicating more severe post-traumatic stress symptoms.

CRIES-8 psychometric properties were assessed in two studies. One involved 87 children who survived a cruise ship sinking (52), while the other included 170 children attending a hospital emergency department after road traffic accidents or sporting injuries (53). Both studies supported the reliability and validity of the CRIES-8 as a screening tool for PTSD. Regarding reliability and validity, the eight-item version (52) showed a strong correlation ($r = +0.95$, $p < 0.001$) with the total score of the 15-item version from which it originated. In a study of 87 shipwreck survivors, those diagnosed with PTSD according to Diagnostic and Statistical Manual (DSM) criteria scored significantly higher (26.0) on the eight-item version compared to those not meeting PTSD criteria (7.8) ($p < 0.001$). An analysis of these scores revealed that a combined score of 17 or more accurately identified >80% of children with a diagnosis of PTSD.

The CPDS is an instrument for assessing children's psychosocial distress and estimating the likelihood of their needing psychological treatment. The instrument was developed in and for non-Western emergencies as a primary screening tool in conflict-affected communities (54) The instrument includes an assessment of the child's traumatic distress, resilience components such as social support, and functioning through five items that are read to the child and then scored on a 3-point scale (0, 1, 2). The total score is in the range of 0–10.

The validity of the tool was tested on children from four countries: Burundi; Sudan; Sri Lanka; and Indonesia. We chose to use a cut-off of 8, indicating the presence of psychosocial distress, based on results from the Burundi sample used for the validation of the instrument, as this was the context closest to that of CAR. Because of its brevity and its ability to be administered by non-specialists, the CPDS can be used as a screening tool for large populations of children affected by conflict (55).

Data analysis

To test whether there were statistically significant differences between the two groups in the sociodemographic characteristics, the chi-square or Fisher's exact test was performed, where appropriate. The independent samples *t*-test was used to test whether there was a difference in age, school level, gender, CPDS, and CRIES-8 between the two groups, for both 661 and 185 samples.

To test whether there were statistically significant differences between the ACF/KONO and G-TEP protocols, both

TABLE 1 Sociodemographic data.

Sociodemographic characteristics	ACF/KONO ($n = 290$)	G-TEP ($n = 371$)	Analysis		
			χ^2	*df*	*p*
Gender, *n* (%)			0.996	1	0.318
Boys	145 (50%)	171 (46%)			
Girls	145 (50%)	200 (54%)			
Education, *n* (%)			2.40	3	0.493
None	14 (4.8%)	25 (6.73%)			
Primary	276 (95.1%)	342 (92.1%)			
Secondary	0 (0%)	1 (0.2%)			
			t	*df*	*p*
Age, M (SD)	11.3 (2.40)	11.8 (2.10)	2.87	658	0.004

M, mean; SD, standard deviation.

pre- and post-treatment, we used a pairwise independent samples *t*-test.

In the sample of 185 children, to check whether there were statistically significant differences between the ACF/KONO and G-TEP groups before, after, and at follow-up, we used a multifactorial ANOVA for the CPDS score, as well as a pairwise independent samples *t*-test for the CRIES-8 score, as the pre-treatment samples did not meet the assumption of homogeneity of variance. The Bonferroni post-hoc test was used to analyze the differences between the ACF/KONO and G-TEP groups' pre-treatment, post-treatment, and follow-up scores.

In the sample of 661 children, we tested whether there were statistically significant differences in the improvement of CRIES-8 and CPDS scores based on sociodemographic characteristics and the two protocols. We calculated the improvement score (the difference between pre-treatment and post-treatment scores) and compared it using multifactorial ANOVA, ensuring Levene's condition was met. Otherwise, the Kruskal–Wallis non-parametric ANOVA were used. We chose to split the age groups into two categories, with 12 years being the median age: the group of children aged 12 years or older comprised 50.3% of the sample, and the group aged 11 years or younger comprised 49.7% of the sample.

$p < 0.05$ was considered to be statistically significant. The statistical analysis was performed using Jamovi statistical software package version 2.3.28.0 [The Jamovi project (2021). Jamovi. Version 2.2, retrieved from https://www.jamovi.org].

Results

The values of the sociodemographic variables between ACF/KONO and G-TEP participants are presented in Table 1. There was no statistically significant difference regarding gender ($\chi^2 = 0.996$; $p = 0.318$) and level of education ($\chi^2 = 2.40$; $p = 0.493$). There was a significant difference in relation to age ($t = -1.0930$; $p = 0.861$), but the distribution between the two groups was not homogeneous (Figure 2). Participants in the G-TEP protocol were older than those in the ACF/KONO protocol.

The CRIES-8 and CPDS scores are shown in Table 2.

The sociodemographic profile of children who completed the study and those who dropped out showed no difference in terms of age ($t = -1.39$ $p = 0.164$), gender ($\chi^2 = 0.893$ $p = 0.345$), and education ($\chi^2 = 2.30$ $p = 0.513$).

A comparison of the psychological profile at the assessment in the pre-treatment phase of children who completed the study with those who dropped out showed no difference in CPDS

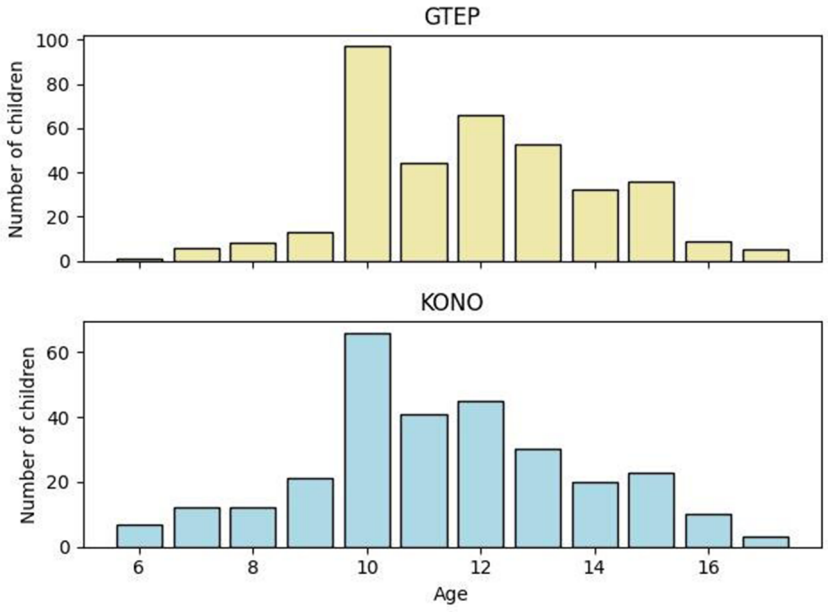

FIGURE 2
Age distribution in the two protocols.

TABLE 2 Mean (8SD) scores in pre-treatment and post-treatment tests in the two protocols.

	Pre		Post	
	ACF/KONO	G-TEP	ACF/KONO	G-TEP
Measure ($n = 661$)				
CRIES-8, M (SD)	27.75 (4.70)	27.75 (5.42)	10.90 (4.90)	10.64 (4.91)
CPDS, M (SD)	7.80 (1.15)	7.72 (1.15)	3.62 (1.46)	3.32 (1.24)

M, mean; SD, standard deviation.

scores ($t = -1.51$; $p = 0.132$) and a significant difference for CRIES-8 scores ($t = 5.73$; $p < 0.001$), indicating lower scores for children who interrupted the intervention.

At the assessment in the pre-treatment phase, the mean CPDS scores of participants in the ACF/KONO group and the G-TEP group did not differ ($t = -0.88$; $p = 0.378$). Nor did the two groups differ in CRIES-8 scores ($t = -0.002$; $p = 0.998$). The mean CPDS scores of both groups showed a level of general distress below the cut-off point of 8. The mean CRIES-8 scores of participants in both groups were well above the cut-off point of 17, underlining high levels of PTSD.

Efficacy of ACF/KONO and G-TEP protocols

The Student's paired-samples *t*-test for ACF/KONO participants showed a significant effect, with reduced scores on the CRIES-8 ($t = 44.8$; $p < 0.001$, effect size = 2.63) and CPDS ($t = 38.2$; $p < 0.001$, effect size = 2.24). The mean post-treatment CRIES-8 score was below the clinical threshold for PTSD (<17), with 11% of children showing scores above or equal to the cut-off. The mean post-treatment CPDS score remained below the clinical cut-off (<8), with 2% of children showing scores above or equal to the cut-off.

Student's paired-samples *t*-test for the G-TEP protocol showed a significant effect, with reduced scores on the CRIES-8 ($t = 49.2$; $p < 0.001$, effect size = 2.55) and CPDS ($t = 57.2$; $p < 0.001$, effect size = 2.97). The mean post-treatment CRIES-8 score was below the clinical cut-off for PTSD (<17); 10% of children showed scores above or equal to the cut-off. The mean post-treatment CPDS score remained below the clinical cut-off (<8); 1% of children showed scores above or equal to the cut-off.

The Student's *t*-test comparing the two groups ACF/KONO and G-TEP showed no significant difference between the two types of treatment between the pre- and post-treatment CRIES-8 scores ($t = 1.744$; $p = 0.514$, effect size = 0.040) (see Figure 3) and CPDS scores ($t = 1.688$; $p = 0.092$, effect size = 0.323) (see Figure 4).

At the post-treatment assessment, the mean scores of participants in the ACF/KONO group and the G-TEP group did not differ for the CRIES-8 ($t = -0.88$; $p = 0.005$) but they were statistically different for the CPDS ($t = -0.687$; $p = 0.492$), suggesting slightly lower values for the G-TEP protocol (see Table 2).

Relation with sociodemographic variables

For the CRIES-8 betterment score, there was a statistically significant interaction between gender and protocol ($F = 5.522$, $p = 0.019$), showing a larger mean betterment score on boys treated with G-TEP (see Table 3), whereas ACF/KONO demonstrated a larger mean betterment score on girls.

There was a statistically significant interaction between age and protocol ($F = 7.238$, $p = 0.007$), showing a larger mean betterment score on children aged 12 years and older treated with G-TEP (see Table 3), whereas ACF/KONO demonstrated a larger mean betterment score on children aged below 12 years.

For the CPDS betterment score, there was no statistically significant difference between gender and protocol ($\chi^2 = 1.90$, $p = 0.594$). There was no statistically significant difference between age and protocol ($\chi^2 = 4.21$, $p = 0.378$).

The effect of education on the betterment score was not analyzed, as 93.8% of children have a primary school education

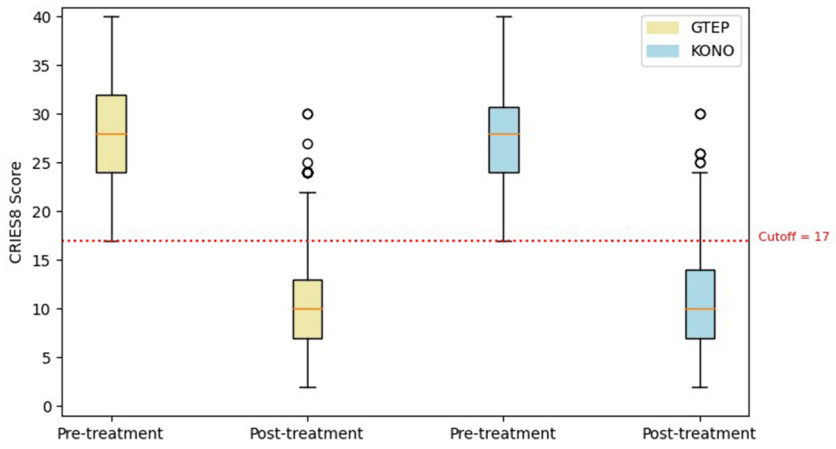

FIGURE 3
Box plot displaying differences in pre- and post-treatment CRIES-8 scores of the two protocols. The circle in the box plot represents extreme values.

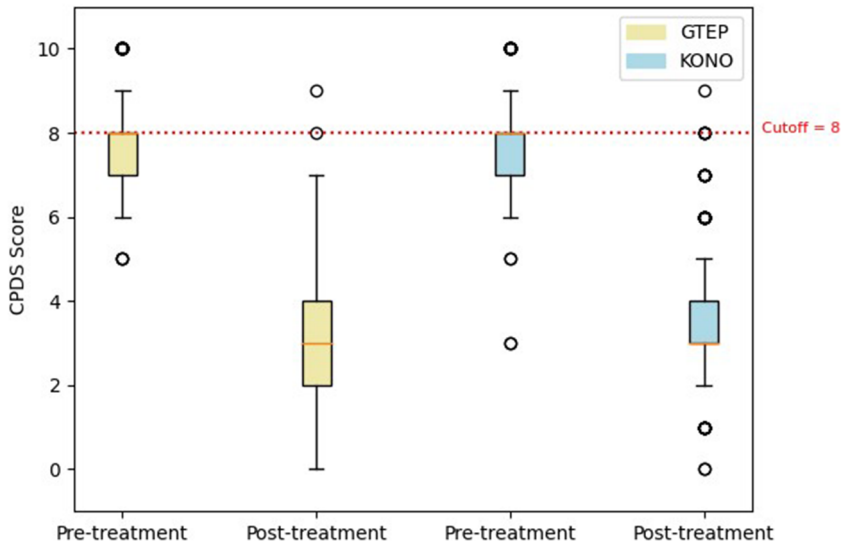

FIGURE 4
Box plot displaying differences in pre- and post-treatment CPDS scores of the two protocols. The circle in the box plot represents extreme values.

(see Table 1), meaning the other groups were not large enough to lead to a statistically significant analysis.

Efficacy of the two protocols after 5 months

Due to the security situation, which prevented access to certain areas, we were able to return to two intervention areas 5 months after the end of treatment to re-measure the CPDS and CRIES-8 scales in 185 children. Details of the sociodemographic variables for this sample are given in Table 4.

In the sample of 185 children with the three measures, pre-treatment, post-treatment, and follow-up after 5 months, a multifactor ANOVA was used to evaluate the CDPS and the CRIES-8 scores over time (see Table 5).

We compared the pre-evaluation profile between children who were re-evaluated for follow-up 5 months after the end of the intervention and those who were lost to follow-up. No significant differences were found for the following sociodemographic variables: age ($t = 1.016$; $p = 0.310$), gender ($\chi^2 = 0.009$; $p = 0.923$), and education ($\chi^2 = 0.883$; $p = 0.830$). No difference was found for scores of CDPS ($t = -0.459$; $p = 0.646$) and CRIES-8 ($t = -1.911$; $p = 0.056$).

Repeated measures analysis on CRIES-8 (Figure 5) revealed a significant group effect ($F = 890.73$; $p < 0.001$). CRIES-8 scores were significantly different before treatment (difference = −2.756, SE = 0.662; $p < 0.001$), with higher values in the ACF/KONO group (see Table 4). There was no significant difference in mean scores between participants in the two protocols for the CRIES-8 after treatment (difference = −0.189; SE = 0.830; $p = 1.000$) and after follow-up (difference = 0.309, SE = 0.706; $p = 0.998$).

The analysis revealed a significant time effect ($F = 5.64$; $p = 0.004$). A Bonferroni *post-hoc* test of the time effect for ACF/KONO protocol of CRIES-8 scores revealed a statistically significant difference between the pre- and post-treatment scores (difference = 16.967, SE = 0.714; $p < 0.01$), between the pre-treatment and follow-up scores (difference = 21.022, SE = 0.681; $p < 0.01$) as well as between the post-treatment and follow-up scores (difference = 4.056, SE = 0710; $p < 0.01$).

TABLE 3 Gender and age mean (and SD) of CRIES-8 and CPDS betterment score according to the protocol.

			G-TEP	KONO
CRIES-8	Gender	Girls, M (SD)	16.6 (6.58)	17.5 (5.86)
		Boys, M (SD)	17.8 (6.81)	16.2 (6.86)
	Age	≥12 years, M (SD)	18 (6.56)	16.4 (6.48)
		<12 years, M (SD)	16.1 (6.73)	17.2 (6.33)
CPDS	Gender	Girls, M (SD)	4.42 (1.44)	4.21 (2.01)
		Boys, M (SD)	4.37 (1.54)	4.14 (1.70)
	Age	≥12 years, M (SD)	4.50 (1.39)	4.21 (1.75)
		<12 years, M (SD)	4.28 (1.58)	4.15 (1.95)

M, mean; SD, standard deviation.

TABLE 4 Sociodemographic data of the sample ($n = 185$).

Sociodemographic characteristics	ACF/KONO ($n = 90$)	G-TEP ($n = 95$)	Analysis		
			χ^2	*df*	*p*
Gender, *n* (%)			1.19	*1*	0.276
Boys	47 (52%)	42 (44.2%)			
Girls	43 (47%)	53 (55.7%)			
Education *n* (%)			3.15	2	0.207
None	3 (3.3%)	9 (9.4%)			
Primary	87 (96%)	86 (90.5%)			
			t	*df*	*p*
Age, M (SD)	11.7 (2.07)	11.9 (1.90)	0.638	183	0.524

M, mean; SD, standard deviation.

TABLE 5 CPDS and CRIES-8 mean scores (SD) for a sample of 185 children with pre-treatment, post-treatment, and follow-up measurements.

	Pre		Post		Follow-up/5 months	
	ACF/KONO	G-TEP	ACF/KONO	G-TEP	ACF/KONO	G-TEP
Measure ($n = 185$)						
CRIES-8, M (SD)	28.6 (4.03)	25.8 (4.90)	11.6 (5.88)	11.4 (5.41)	7.53 (4.15)	7.84 (5.34)
CPDS, M (SD)	7.66 (1.30)	7.78 (1.08)	3.35 (1.63)	3.53 (1.26)	2.89 (1.77)	2.43 (1.51)

M, mean; SD, standard deviation.

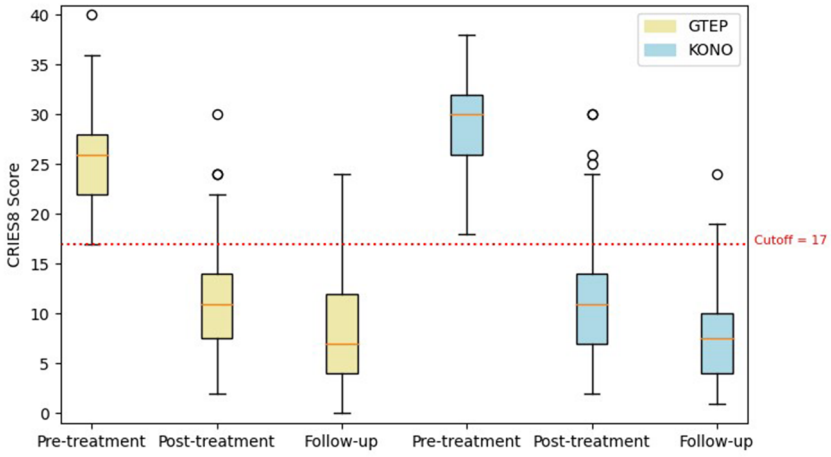

FIGURE 5
Box plot displaying differences in pre- and post-treatment CRIES-8 scores and follow-up of the two protocols. The circle in the box plot represents extreme values.

The Bonferroni *post-hoc* test of the time effect for G-TEP protocol of CRIES-8 scores revealed a statistically significant difference between the pre- and post-treatment scores (difference = 14.400, SE = 0.695; $p < 0.001$), between the pre-treatment and follow-up scores (difference = 17.958, SE = 0.663; $p < 0.001$), and between the mean post-treatment and follow-up scores (difference = 4.056, SE = 0.710; $p < 0.001$).

Group by time interaction was not significant for CRIES-8 scores ($F = 3.47$; $p = 0.064$).

Repeated measures analysis on CPDS scores (Figure 6) revealed no significant group effect ($F = 0.114$; $p = 0.736$): there was no significant difference in CPDS mean scores between participants in the ACF/KONO and G-TEP protocols, before treatment (difference = 0.123, SE = 0.176; $p = 0.981$), after treatment

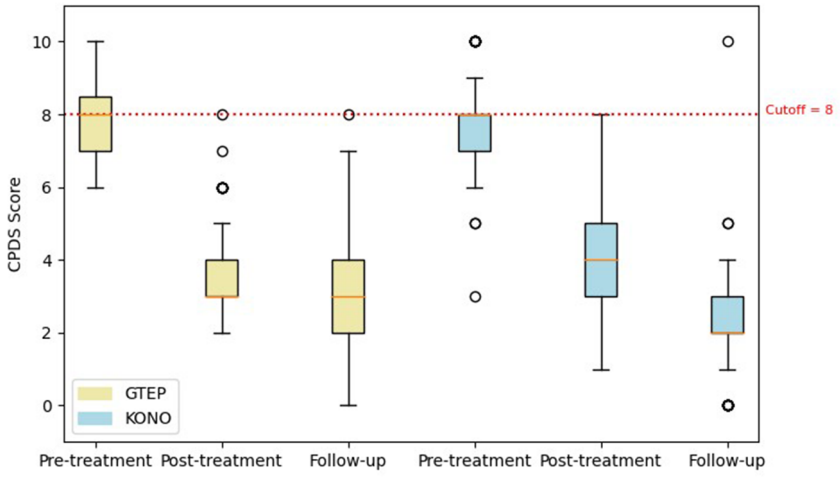

FIGURE 6
Box plot displaying differences in pre- and post-treatment CPDS scores and follow-up of the two protocols. The circle in the box plot represents extreme values.

(difference = 0.451, SE = 0.214; $p = 0.285$), and at follow-up (difference = 0.461, SE = 0.242; $p = 0.403$).

The analysis revealed a significant time effect ($F = 681.35$; $p < 0.001$).

The Bonferroni *post-hoc* test of the time effect for ACF/KONO protocol of CPDS scores revealed a statistically significant difference between the pre-treatment and post-treatment scores (difference = 3.678, SE = 0.194; $p < 0.01$), a statistically significant difference between the pre-treatment and follow-up scores (difference = 5.222, SE = 0.207; $p < 0.01$) as well as a statistically significant difference between post-treatment and follow-up scores (difference = 1.544, SE = 0.218; $p < 0.01$).

The Bonferroni post-hoc test of the time effect for EMDR/G-TEP protocol of CPDS scores revealed a statistically significant difference between the pre-treatment and post-treatment scores (difference = 4.253, SE = 0.189; $p < 0.001$) and between the pre-treatment and follow-up scores (difference = 4.484, SE = 0.201; $p < 0.001$). There was no significant difference between the mean post-treatment and follow-up scores (difference = 0.632, SE = 0.212; $p = 0.038$).

Group by time interaction was significant (F = 5.13; $p = 0.006$).

In both protocols, mean scores after treatment and at follow-up remained below the clinical cut-off for both CPDS (<8) and CRIES-8 (<17). The percentages of children with scores above or equal to the clinical cut-off after treatment and at follow-up are detailed in Table 6.

Summary of the results

In total, 661 children (290 for ACF/KONO and 371 for G-TEP) benefited from all treatment sessions.

ACF/KONO and G-TEP participants showed no statistically significant difference on sociodemographic variables, except for age: participants in the G-TEP protocol were older than those in the ACF/KONO protocol. At the pre-treatment assessment, the mean CPDS scores did not differ between the groups ($t = -0.88$; $p = 0.378$), nor did the two groups differ in CRIES-8 scores ($t = -0.002$; $p = 0.998$). The mean CPDS scores of both groups showed a level of general distress and the mean CRIES-8 scores in both groups showed high levels of PTSD.

After the intervention, ACF/KONO participants showed a significant reduction on CRIES-8 ($t = 44.8$; $p < 0.001$, effect size = 2.63) and CPDS ($t = 38.2$; $p < 0.001$, effect size = 2.24). Participants in the G-TEP protocol showed a significant effect, with reduced scores on the CRIES-8 ($t = 49.2$; $p < 0.001$, effect size = 2.55) and CPDS ($t = 57.2$; $p < 0.001$, effect size = 2.97). Student's *t*-test comparing the ACF/KONO and G-TEP groups showed no significant difference between the pre- and post-treatment CRIES-8 scores ($t = 1.744$; $p = 0.514$, effect size = 0.040) and CPDS scores ($t = 1.688$; $p = 0.092$, effect size = 0.323). The results for CRIES-8 showed a statistically significant interaction between gender and the type of protocol used, showing a bigger improvement in boys treated with G-TEP, unlike the ACF/KONO protocol, showing a bigger improvement in girls.

There was a statistically significant interaction between age and protocol type: children aged 12 years and over showed a bigger improvement with the G-TEP protocol, while children aged under 12 years showed a bigger improvement with the ACF/KONO protocol.

For the CPDS improvement score, there was no statistically significant difference between the gender and age variables and the protocols.

An analysis of the follow-up data for the 185 children showed that the effects of both protocols are maintained over time, with mean scores before treatment and at follow-up below the clinical cut-off for both CPDS (<8) and CRIES-8 (<17).

TABLE 6 Number (%) of children above the cut-off scores (sample $n = 185$).

	CRIES-8				CPDS			
	G-TEP		ACF/KONO		G-TEP		ACF/KONO	
	n	%	*n*	%	*n*	%	*n*	%
Pre-treatment	95	100%	90	100%	61	64%	52	58%
Post-treatment	14	15%	16	18%	1	1%	3	3%
Follow-up	5	5%	2	2%	1	1%	1	1%

Discussion

The aim of this study was to evaluate whether the G-TEP protocol could be an alternative to the ACF/KONO protocol, which has been used for several years by the NGO Action contre la Faim in humanitarian emergency contexts. This need emerged from the fact that few proposals for clinical management and reduction of traumatic symptoms are offered to children in situations of exposure to mass trauma. Literature reviews on mental health and psychosocial support interventions for children in low- and middle-income countries, particularly in conflict situations, highlight a strong need for structured therapeutic protocols that can be deployed on a large scale (56, 57).

One difficulty that limits psychological support interventions for children is the lack of professionals trained in the management of children's trauma, particularly in developing countries where there are few, if any, training curricula on the subject. To meet the significant psychological support needs of children affected by crisis situations, such as conflicts, natural disasters, epidemics, etc., it is necessary to be able to offer psychological interventions carried out by duly trained and supervised mental health paraprofessionals (58, 59).

The ACF/KONO protocol has been designed to enable paraprofessionals to set up a treatment program to reduce symptoms of trauma in children. Until the current project, ACF had never used the G-TEP protocol on children. To our knowledge, very few studies have been carried out on the efficacy of G-TEP for children, and no publications are currently available. Our study was based on data collected within an ACF psychological support project, which enabled a comparison between the ACF/KONO protocol and the G-TEP protocol. The project was complicated by the specific conditions of the humanitarian field, where it is often difficult to guarantee a certain rigor in the implementation of interventions and in data collection (60).

In the specific case of the Central African Republic, the project was carried out in an area of ongoing conflict, which prevented regular access to the intervention zones by either the team or the participating children. Despite these difficulties, which prevented the 16% of children initially included in the project from attending regularly, participation was remarkably high. A total of 661 children attended the five sessions planned by each of the two therapeutic systems. This program was the first to use two post-traumatic symptom reduction protocols with such a large sample in a context of insecurity and conflict. This remarkable participation in psychological sessions in a context of extreme precariousness and danger can also be interpreted as an important indicator of the interest and priority given to such care for children, by families and communities, even though the program did not provide any benefits or financial advantages. Another objective of the study was to check whether the treatment results were maintained over time. Indeed, the activities proposed in this program were carried out very soon after exposure to critical incidents in a context of chronic and repetitive violence and insecurity. Early interventions in acute phases aim to both treat post-trauma symptoms and prevent the development of chronic PTSD (61) as it is important to be able to offer affected populations both immediate relief from their traumatic suffering and to limit the installation and chronicization of traumatic symptoms. It was impossible to contact again all the children who had participated in the program for a follow-up reassessment after the end of treatment. However, it was possible to reassess the wellbeing and level of traumatic symptoms of 185 children 5 months after the end of treatment. The data collected were sufficiently substantial to enable us to provide answers on the long-term efficacy of these two protocols.

With both the ACF/KONO and G-TEP protocols, the CDPS and CRIES-8 scores decreased significantly after treatment. Very few children showed symptoms of trauma after treatment with either protocol. Our results show that both protocols are effective in improving wellbeing and treating trauma in children. There was a difference in post-treatment CDPS scores, which were significantly better using the G-TEP protocol.

Analyses carried out on the sample of children who received an assessment 5 months after treatment showed that the effects of both interventions are maintained, and even continue to decrease significantly, over time. These results confirm that these early interventions may also have a role to play in preventing the chronicization of post-traumatic symptoms.

The results show no significant difference between the two protocols in terms of either improvement in general wellbeing or reduction in traumatic symptoms. The only difference was in the effects between post-evaluation and follow-up. The G-TEP protocol did not show a significant difference in CPDS scores. This small difference does not suggest a significant difference in the efficacy of the two protocols. At the pre-treatment assessment, the children showed very high scores on the CRIES-8, indicating a significant level of traumatic symptoms. However, the CPDS scores were below the cut-off score of 8, although they were not far from it (ACF/KONO: $M = 7.80$, $SD = 1.15$; G-TEP: $M = 7.72$, $SD = 1.15$). This may be due to the choice of cut-off score, which may need to be adjusted for the CAR target population. The CPDS validation paper shows that the tool can be used in many different cultural contexts for the assessment of non-specific psychosocial distress, as the constituent elements of psychosocial distress may be similar from one context to another, but the specific way in which they manifest themselves could be different. The use of a different cut-off score may be more relevant in CAR and may be the subject of further research, as the contextual validity of validation tools is strongly recommended (62, 63).

The analysis of sociodemographic data in relation to the two protocols showed that girls performed better with the ACF/KONO protocol, and that older children performed better with the G-TEP protocol. It may be premature to advance generalizable conclusions based on this study; however, we can propose some hypotheses.

The ACF/KONO protocol is a trauma-focused narrative protocol, and the traumatic experience is verbalized and thus shared within the group. The G-TEP protocol, on the other hand, proposes individual work within a group (each child works on his or her own sheet of paper). This difference in the nature of the protocol could explain why the data show a gender difference in effectiveness. Boys may be more comfortable with a more individual approach, where the expression of their emotional experience is more reduced. Girls may be more comfortable recognizing and expressing distress in a group setting. Furthermore, in the G-TEP protocol, the child, guided by the paraprofessional, processes his trauma and connects to his past, present, and future resources, whereas the ACF/KONO protocol, through the group and narrative, also encourages the child to rely on others, on external resources, to overcome his difficulties. The way in which people cope with and manage their difficulties in order to get better may also be gendered in Central African culture and could explain the differences observed.

The nature of the protocol could also explain the age-related difference in score improvement: the ACF/KONO protocol involves the use of picture boards representing the life of a hippopotamus that faces difficulties and then copes with them with the help of those around it and the reinforcement of his own internal resources. Although this protocol has proved effective in several contexts for implementing mental health and psychosocial support projects, the images used seem to be better suited to younger children. It might be appropriate to adapt the images and protagonists of the protocol for an adolescent audience, to facilitate projection and identification. More in-depth studies could focus more on children's appreciation of the two protocols and their feedback about the protocols, emotional sharing and traumatic experiences within the group, to test the hypotheses proposed here. They could also provide new criteria for arbitration between the two protocols according to child populations and contexts.

With minimal differences, both protocols reduced children's symptoms of trauma and were therefore contextually appropriate for use with children in humanitarian crisis situations.

The results presented in this study confirm the findings of previous studies on the use of the ACF/KONO protocol (43), as

well as the unpublished results obtained in the NGO's programs set up in several humanitarian contexts.

As for the G-TEP protocol, given the lack of publication on its use with children, we can base our observations on results obtained with adults. Our results confirm those of studies describing the use of G-TEP with an adult population (25). In addition, the results of this study are similar to the results of studies on the comparison of treatment between G-TEP and a CBT protocol with adults in Iraq (49) and the Central African Republic[1], in which post-traumatic symptoms decreased significantly with each protocol; however, there was no difference in efficacy between the two protocols. In adults in CAR, as in our study with children, the G-TEP results were greater in men than in women, perhaps highlighting a gender-related cultural difference depending on the protocol.

Both protocols were conducted by paraprofessionals under the supervision of clinical psychologists, remotely and in the field. This shows that both types of treatment are feasible in the real-life conditions of a humanitarian context and lack of specialized personnel. This confirms that it is possible to fill gaps in mental health and psychosocial support using paraprofessionals (64), with technical supervision provided by mental health specialists (32, 65, 66).

The use of the G-TEP protocol was tested to answer clinical questions following the use of the ACF/KONO protocol. The data showed that both protocols were equally effective in reducing children's traumatic symptoms, both at the end of treatment and 5 months later.

The reduction in symptoms of trauma is due to the psychic elaboration mechanisms underlying each protocol, which have points in common, but also important differences.

Among the points in common, there is the fact of working on individual psychic resources to help children contextualize the traumatic event and put it into perspective in a more appropriate personal narrative so that the traumatic traces are less painful, and the prospect of the future can be envisaged. In both protocols, drawing is used to externalize internal experiences, which take shape through a trace on paper. Physical and visual anchoring helps to set traumatic experiences and personal resources in movement, breaking out of the immobility of the traumatic experience.

The group helps break out of the isolation characteristic of traumatic symptoms and to regain the security needed to process the traumatic experience.

We observed two differences in particular that seem to differentiate the protocols, the first being linked to the structure of the two treatment devices.

One of the reasons for testing G-TEP was to find a protocol that could be as effective as the ACF/KONO protocol, but with greater flexibility for use in volatile contexts in conflict situations. In fact, each G-TEP session is identical, enabling participants to work on traumatic events. Its effectiveness has been demonstrated with a limited number of sessions with adults (from the very first session). The ACF/KONO protocol, on the other hand, has a narrative structure that requires all five sessions to be completed. Our results confirm that both protocols are equally effective over five sessions; however, our data do not allow us to know whether the results obtained are faster with one protocol than the other. To answer this question, it would be interesting to measure distress and post-traumatic stress at each session, or at least in the middle of the treatment, to see whether G-TEP would be more effective more quickly.

The second difference between the protocols concerns the fact that the ACF/KONO protocol offers a space for talking about difficult and painful moments, which is not the case in the G-TEP protocol, where group sharing is focused on positive aspects and projection into the future only. This point should also be considered in the vicarious trauma of the psychosocial workers who lead the sessions.

Paraprofessionals working in conflict zones are often people who are themselves affected by the situation in their own country, and who come to the aid of their compatriots (67).

The impact of each protocol on the teams could be another key factor to consider when choosing protocols. G-TEP may be more protective of traumatic transmission since the children do not share their traumatic experiences verbally (68). In this study, we were unable to compare vicarious trauma and/or the impact of the protocols on the teams, as the same teams worked on both protocols. However, it would be useful to conduct a study in the future that would assess the consequences of the type of protocol chosen on teams' emotional wellbeing, vicarious trauma, and other variables, such as burnout, motivation, and compassion fatigue.

The choice of protocol could be guided by the composition of the groups, given the observed differences in age and gender, as well as the appetence of paraprofessionals or children benefiting from the therapeutic device.

Although further studies are needed to support the results presented in this paper, the data are very encouraging about the possibility of using these two protocols in humanitarian contexts and by paraprofessionals.

In conclusion, this retrospective study confirms the validity of the strategy for scaling up this EMDR-adapted protocol for children. It shows that the G-TEP protocol conducted by paraprofessionals reduces post-traumatic symptoms in children aged 6–17 years as effectively and significantly as the ACF/KONO protocol over five sessions. These results were maintained 5 months after the end of treatment, even though the children were still living in a context of chronic insecurity and violence. These treatments were carried out by paraprofessionals supervised by psychologists in a humanitarian program that was as close as possible to the realities of emergencies and enabled over 661 children to be treated over a 10-month period. They open up new perspectives on the possibility of offering children effective approaches to treating their post-traumatic symptoms by deploying large-scale programs with non-specialized but well-trained and supervised staff.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval was not required for this study, as this is a retrospective study performing secondary analysis. Written informed consent to participate in this study was obtained from the participants or the participants' legal guardians/next of kin.

Author contributions

ED: Conceptualization, Data curation, Formal Analysis, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. CB: Conceptualization, Methodology, Writing – review & editing. VW: Data curation, Investigation, Methodology, Supervision, Writing – review & editing. NA: Formal Analysis, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Feasibility, acceptability, and perceived benefits of a creative arts intervention for elementary school children living with speech, language and communication disorders

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Background: Children with speech, language, and communication disorders require specialized support in response to their emotional expression challenges. Not only is such support key for their development, but it is also essential for their mental well-being. Art making emerges as a valuable tool for enabling these children to convey emotions both verbally and non-verbally, fostering a positive self-concept. School-based arts interventions have the potential to improve self-concept and emotional expression, and more generally, the quality of life. However, there is limited empirical evidence regarding the feasibility, acceptability, and perceived effectiveness of a manualized, school-based creative arts intervention for this specific group.
Aim: This study aimed to develop and evaluate the feasibility, acceptability, and perceived benefits of an art-based intervention for elementary school students with speech, language, and communication disorders, using qualitative methods to obtain diverse perspectives.
Results: The findings indicate that the intervention was feasible and well received, as reported by teachers, students, and facilitators. Participants also discussed potential positive outcomes, including emotional expression, emotional growth, and fulfilment of autonomy, competence, and relatedness needs. Students found the workshops conducive to sharing emotions and took pride in the creative process. Teachers gained deeper insights into their students, fostering positive classroom relationships. Observational data triangulated these findings.
Conclusion: This innovative project suggests that art-based interventions can potentially benefit students' emotional expression, but further experimental studies are needed to substantiate these effects.

KEYWORDS

art-based intervention, school-based intervention, children's mental health, speech, language, communication difficulties (SLCD), therapeutic arts, self-determination theory (SDT)

1 Introduction

Children with speech, language and/or communication disorders (SLCD), an umbrella term for the various problems in the realm of communication, experience difficulties in receptive and expressive language and the social use of language. The American Speech-Language-Hearing Association defines speech disorders as impairments in creating speech sounds, including articulation and fluency (1). Language disorders include problems in comprehension (receptive; understanding others) or use of spoken and/or written information (expressive; conveying a message). Communication disorders include speech disorders, language disorders, as well as hearing disorders (1). The prevalence of SLCD ranges from 9% to 13% in the general population (2, 3). These difficulties are often comorbid with various mental health and neurodevelopmental diagnoses, including autism spectrum disorder (ASD), attention deficit and/or hyperactivity disorder (ADHD), depression, anxiety, as well as other social and behavioral difficulties, such as aggressive behaviors (4–7). Although interventions that target everyday language and communication skills are essential to support children with SLCD (8, 9), it is also important to simultaneously provide mental health support to enable emotional awareness and expression, as these children often suffer psychological consequences of their communication difficulties (6). However, relying on typical verbal therapies can undermine the advantages of such mental health interventions with this population (10). Mental health professionals who work with children with SLCD identified that this population needs specific adaptation of typical talking therapies like cognitive-behavioral therapy (CBT), as they may have difficulties in conversation, language interpretation, and expression of their thoughts and emotions (11). For example, adapting CBT to include a focus on bodily sensations and other substitutions to talking are strongly advocated for by these therapists (11). Hence, approaches using the arts as an alternative way to promote emotional awareness and expression may be especially beneficial for children with SLCD (12).

1.1 SLCD and self-determination theory

Although children with SLCD are more at risk of developing various mental health problems (13), very few interventions specifically target mental health symptoms like anxiety or depression. To date, research including students with various learning disabilities and SLCD has focused on supporting children's basic psychological needs for autonomy, competence and affiliation to foster well-being in many different life domains (14–17). Self-determination theory, a macro theory of human motivation, posits that supporting these universal psychological needs is essential for a flourishing life (18). The need for autonomy can be defined as the desire to experience a sense of volition and choice. It involves feeling that one's own behavior and action is self-directed and congruent with personal values and interests. The need for competence consists of seeking to be effective and capable in handling challenges and achieving desired outcomes. This includes mastering skills and accomplishing meaningful tasks. Finally, the need for relatedness refers to the desire to connect with others, experience meaningful social relationships, and feel a sense of belonging within a social context. Creating spaces that support these three psychological needs can foster children's creativity, motivation, and school engagement (18). Children with SLCD could particularly benefit from interventions that support their autonomy, competence, and relatedness, as they face additional challenges in these domains (19). Indeed, autonomy, supportive experiences, feeling connected to peers, and tasks that enable a sense of competence can all contribute to emotion expression through introspection and self-understanding (20). Art-based interventions may be particularly beneficial for introspection and emotional expression in youth who may not possess the vocabulary to thoroughly describe their emotions (21). As such, these interventions can facilitate communication for children who experience trouble verbally communicating their thoughts and feelings, which could, in turn, foster feelings of competence (21, 22). Furthermore, the focus on subjective experiences and the creative process, rather than the finished piece of art, makes such interventions particularly suitable for children with SLCD. However, to date, no research has evaluated whether art-based interventions can effectively promote emotional expression and self-determination in children, namely those with SLCD.

1.2 Art-based interventions

Art-based approaches may be particularly beneficial for children and adolescents. Traditional therapeutic methods like individual psychotherapy have become increasingly inaccessible, and wait-lists times are at an all-time high (23, 24). Hence, art-based approaches could serve as an effective alternative for youth, particularly as they provide a sense of empowerment and prompt participants to share their work, thoughts, and feelings with their peers (25, 26). In youth populations, art-based interventions have namely served to overcome resistance to therapy (21). Furthermore, the arts (e.g., painting, sculpture, dance, etc.) allow psychologists to adapt their interventions according to the demographic they are working with. This capacity to adjust an approach is crucial to create interventions that align with the context of their participants, such as offering age and culturally appropriate activities (27, 28). Hence, art-based interventions have a promising potential to allow for introspection and emotional expression in children, supporting their mental health.

School settings may be particularly suitable for implementing art-based interventions. Indeed, in a review of eight studies involving school-based arts interventions among children aged 5–12 years old, Moula (29) found that integrating creative arts into the classroom had significant positive effects in improving children's quality of life, anxiety, self-concept, problem-solving skills, attitudes towards school, as well as emotional and behavioral difficulties. Another review of the literature on school-based art therapy found that creativity, expression of emotions through art, and finding meaning within the artwork could lead to better classroom behavior, improved self-concept, and help with separation anxiety disorder in children (30). However, only four experimental studies met the inclusion criteria for the review and the authors highlight

that further evidence is needed to support these findings. Although few studies have examined the potential mental health outcomes of school-based art interventions, initial evidence from the present research team supports that art therapy can improve children's well-being and reduce psychological distress (31). Moreover, school-based drama therapy for children with autism and/or various developmental disorders has been linked to improved confidence in expressing emotional needs, increased use of creativity and imagination, and improved working memory (32). Other effective art-based interventions in schools include storytelling, drawing, puppetry, songwriting, and activities based on empowerment, such as creating characters based on children's *superpowers* (33). Noted benefits from these creative activities include children's increased sense of personal strength, confidence, identity, and positive emotions (33). Art-based interventions can also extend therapeutic relationships when conducted in a group setting, particularly when creative and interpretive processes are combined (25). Indeed, group settings can provide additional value to art-based interventions through peer support, self-regulation, and cooperation (34). School-based art interventions, when conducted in group settings, can also improve children's self-acceptance and acceptance of others. A qualitative systematic review of the mechanisms of change of school-based art therapies posits that the school context, the process of art-making and reflecting on the artwork were important components of positive change (35). Authors recommend art-based approaches for children who struggle to verbalize their challenges, difficulties, and emotions. However, to our knowledge, there is no evidence regarding the integration of art-based workshops to improve the emotional expression of children with SLCD. Noteworthy are some studies that explored music therapy to enhance motor skills of children with SLCD. While these approaches may be beneficial in promoting various components of language (36, 37), there is a lack of evidence on its potential benefits for this populations' mental health.

Qualitative research has a unique potential for studying arts' creative, embodied and artistic dimensions, with more emphasis on the individual's experience, while embracing complexity rather than reductionism (38, 39). In fact, there has been an increased call for the inclusion of participants' voices in research on the use of creative arts in therapy (29, 38). Within the context of school-based art interventions specifically, the students' and teachers' perspectives on the art interventions have generally been excluded from the published research to date. Including these perspectives early on in the development of art-based interventions would arguably enhance the participants' experience and researchers' understanding of results (29).

1.3 Aim

The objectives of this qualitative study were to explore (1) the acceptability and feasibility of an art-based intervention for elementary school students with SLCD, (2) the perceived benefits of the intervention on children's mental health from the perspective of the students and the educational staff, as well as through observational data.

2 Materials and methods

2.1 Design

The initial stages of program development should rely on various forms of qualitative data to document if the intervention should be further refined to better reflect the needs of the population (40). As such, early research evaluating interventions does not need to include large samples both for feasibility and ethical reasons. Instead, it is recommended to include fewer participants and gain insight into their experiences of the intervention, as well as obtain their recommendations (40). Once an intervention is refined and initial testing done, its efficacy can be documented with larger samples and quantitative methods. However, at the time of study, the present intervention was still at its early development stages. The development of the program had been ongoing within the research team and previously piloted with smaller groups. As such, the present study allowed for the beginning of the next stage of documenting the acceptability and feasibility of the intervention with the population directly.

A descriptive qualitative design was used in this study. Data were obtained through individual semi-structured interviews with the students, the teachers and specialized education technicians, as well as through focus groups and observational data collected during the workshops. This design was implemented to examine the participants' perceptions of the art-based intervention, acknowledging the subjective nature of their experience. This approach was guided by a pragmatic paradigm, focusing on what "works," deriving context-dependent meaning through human experience (41). Our team chose a qualitative design based on the general recommendation that preliminary studies need to focus on the acceptability and feasibility of a new intervention rather than on its efficacy. This allows for changes to be done to the intervention's components before they are evaluated for their efficacy on specific mental health variables (42). This is not to say that the intervention's perceived effects (benefits/drawbacks) are not to be investigated, as the participants' perception is central to evaluating its acceptability and feasibility. Hence, acceptability and feasibility studies aim first to explore whether an intervention can be done, how it should be done optimally, and if we should carry out further testing (43).

There is no consensus on the definition of acceptability within intervention research (44). The present paper follows the theoretical framework of acceptability (TFA) proposed by Sekhon et al. (45), whereby acceptability is "a multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experienced cognitive and emotional responses to the intervention" (p. 1). As such, acceptability integrates the attitudes, satisfaction, and perceived feasibility of a study by the participants who directly experience the intervention, stakeholders, and those who deliver the intervention (44). The TFA includes seven components of affective attitude towards the intervention: perceived burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness, and self-efficacy (45) (p. 7). The feasibility of the intervention can be understood as its usability

(46). In the present study, this included the perception that the intervention was doable, easy to implement/use, that the materials were appropriate, and that the time constraints were well adapted to the context (45). In short, feasibility answers questions regarding whether the intervention can be done and can be differentiated from a pilot study that evaluates aspects of a study design and procedures for implementing a future larger-scale trial (43).

2.2 Participants

Study participants included two groups: (1) children with SLCD and (2) school personnel. Twenty children with SLCD aged 8–12 years old from two classrooms participated in the activities, the focus groups, and individual interviews. Two teachers and two specialized education technicians participated in this study. To be placed in these classrooms, communication difficulties experienced by the children had to be identified as moderate to severe (based on the level of impairment and need of support) by the school psychologist and/or a speech pathologist. Most children from these classrooms also experienced comorbidity with either mild intellectual disability, ASD, ADHD, or oppositional defiant disorder; however, the list of comorbidities and severity was not disclosed to the researchers, and this information was shared verbally by the teachers, and thus we could not include detailed information on this. Special needs presented by the children included repeating many times in different words the instructions, wearing a remote microphone for students with hearing aids, and speaking clearly. Observations did not indicate severe speech impairments, as all of the children were able to share their thoughts and experiences.

The two classrooms were recruited from an ongoing partnership between the corresponding author and principal investigator of this study (CMH) and an elementary school in the province of Quebec, Canada. Both classrooms were adapted for the needs of children with SLCD (e.g., a full-time specialized education technician in class, smaller class size, etc.). The inclusion criteria for the school were to be a francophone or anglophone elementary school in the province of Quebec, Canada with specialized classes for children with SLCD. There were no additional exclusion criteria. Parents consented to their child participating in the art-based activities, focus groups, and individual interviews. Verbal assent was also obtained from the children for the focus groups and the interviews. Teachers and specialized education technicians who agreed to participate in the intervention conveyed their full informed consent to host the workshops and participate in a brief post-project interview. The present study obtained the approval of Bishop's University ethics board (102682).

2.3 Intervention

The arts-based intervention used in this project was developed by a child psychologist (CMH) and a Ph.D. student in clinical psychology (TLG), in collaboration with a researcher with extensive training in dance and movement therapy (AM). Themes were first chosen based on prior research projects led by the research team using art-based approaches to improve elementary school-aged children's mental health [see (21, 39)]. The choice of various art mediums was done in collaboration with both teachers taking part in the project. The 8-week intervention included different art mediums to address each weekly theme. Many complementary mediums were chosen to appeal to the different preferences of children, as well as promote various domains of creativity. As such, mediums included drawing with coloring pencils and crayons on white pieces of paper, as these mediums are easily accessible to children, and non-threatening. Crayons also allow for the exploration of perceptual components and symbolism within art (47). Play-Doh and Lego were chosen to encourage the kinesthetic components of art, which promote body awareness and release of tension (47). Further, these mediums are also familiar to children and easily accessible to allow a feeling of comfort and encourage creativity within cognitive development. Dance was also chosen to further bring consciousness to internal emotional experiences, promote emotional awareness and expression, as well as to release stress and tension (48). While music therapy could be beneficial for exploring emotions while promoting motor skills, it is recommended that these be led by a licensed music therapist with extensive training (36, 37). Further, with the limited time constraint, we wanted to repeat each art medium at least once to promote feelings of competence, so we limited the number of mediums included. The breakdown of the intervention mediums and themes can be found in Table 1. Drawing, sculpting (including the use of Lego and Play-Doh), and dance were selected to introduce a variety of accessible means of creation and expression for the students. Workshops were led by a clinical psychology Ph.D. student (TLG), who was assisted by an undergraduate psychology student, and both were supervised by a child clinical psychologist (CMH). Each weekly 50 min workshop around one theme was divided as follows: instructions, artistic creation with one medium, group discussion, sharing and presenting the creations to the group. The art-based activities were selected to encourage introspection, emotional awareness, and expression in children. The Canadian school curriculum for elementary schools already includes visual art classes. These classes aim to teach various art techniques and mediums and "To learn to create, interpret and appreciate artistic productions as a means of integrating an artistic dimension into their daily lives" (49). In this context, the children's visual art is evaluated for its content (coherence, organization, complexity of artistic elements). In contrast, the aim of art-based therapeutic approaches is to focus on the process of creation and less on the finished art piece (50). Children are rather encouraged to express themselves, focusing on various internal experiences (thoughts,

TABLE 1 Breakdown of the art-based activities.

Intervention week	Art medium	Theme
1	Drawing	Ugly drawing
2	Dance	Emotions
3	Sculpture	Family
4	Lego	Self-portrait
5	Dance	If you were an animal
6	Sculpture	Safe space
7	Lego	Something scary
8	Drawing	Recap of the activities

emotions, physical sensations) related to art-making. As such, special care was taken during the intervention to differentiate these different creative spaces, emphasizing that the finished piece would not be evaluated, and children were never obliged to share them.

2.4 Data collection

In line with a pragmatic approach, data were obtained from four sources to triangulate the findings: focus groups after each workshop, observations during each activity, individual semi-structured interviews with the children and individual semi-structured interviews with teachers and specialized education technicians at the end of the intervention.

After each activity, the weekly focus groups were led by the first author of this paper and included questions about what the children had created, if there was something they wished to share with the group, how they appreciated the activity, if the activity was challenging in any way, and how the activity related to their everyday life. These discussions were recorded and transcribed (mean duration of group discussions = 8.15 min).

An undergraduate student in psychology, who acted as a research assistant, took observational notes during each activity based on an observation grid (see Supplementary Table 1). Questions from this grid included: *What are the reactions to the activity? What roles (leadership, listening, oppositional, etc.) did the children take? What were the interactions during the workshop? What did the children do or say*? The first author, who led the group discussions, also added any additional observations after the workshops.

After the eight-week intervention, each student participated in a brief individual semi-structured interview. These were recorded and transcribed (mean duration of interviews = 11.92 min). The interview guide included questions about children's perception of the activities, and if there were things they had not understood or would have been done differently (see Supplementary Table 2). The first author and a research assistant led these interviews in separate rooms in the school. Special care was taken when developing the interview guide to use words that were easy to understand and questions that were also easily comprehended. Further, children were told that questions could be repeated, that they could take all the time they needed to answer and find their words. The last drawing made (summary of the activities from the child's perspective) also guided the interviews, as children could point to elements on their drawing to describe their answers. Interviewers also took care to summarize what they understood from the children's answers and ask them if it reflects what they experienced.

Finally, the teachers and the specialized education technicians from each classroom participated in semi-structured interviews in pairs (teacher with the class specialized education technician; mean interview time = 43.83 min). These interviews were conducted online on the Microsoft Teams platform (version 1.5.00.31168), housed on a secured server. Semi-structured interviews aimed to obtain the teachers' and technicians' perceptions of the intervention to find out what they thought had worked best and could be improved, as well as the perceived benefits of participating in these activities (see Supplementary Table 3). All interviews were recorded and transcribed for analysis.

2.5 Analysis

Given the clear criteria related to the acceptability and feasibility TFA framework of Sekhon et al. (45), content analysis was used to analyze data. This deductive approach to qualitative coding allowed for the application of a theory to the data (51). The transcriptions were analyzed using MaxQDA Plus 2022 (Release 22.7.0). Codes were first defined. Two researchers (MB and JP) then immersed themselves in the data, by reading and re-reading the transcripts, getting a sense of it as a whole (preparation phase); open coding of the codes was then applied. Interviews were then independently coded by a third researcher (TLG). A flexible approach was also used to allow any additional codes to emerge inductively. Next, all codes were grouped into meaningful categories through extensive discussions between researchers.

Following the deductive analysis, an inductive thematic analysis with a description-focused coding strategy was used to closely represent the participants' specific behaviors, experiences and perceptions (52) to answer research questions regarding mental health. The method proposed by Braun and Clarke (53) guided the analysis. After the transcription and familiarization phase, one researcher (TLG) generated the initial codes, guided by the research questions. These initial codes were discussed with and reviewed by a second research team member (CMH). Three independent coders (TLG, MB, JP) then analyzed the transcripts using the same coding tree. Next, the codes were grouped into overarching categories representing themes within the data to ensure that they closely represented the voices of participants. The validity, coherence and consistency of these categories were discussed with the research team. Finally, overarching themes were named and defined. Data from the observation of the activities and the reflective journal were combined and used to add to the emerging themes from the interviews and focus group data. Hence, results present these themes that are rooted in the transcripts and closely represent what participants experienced and shared within this study.

3 Results

Thematic analysis yielded four overarching themes: acceptability of the activities, feasibility and implementation strategies, positive perceptions during the intervention, and valuable components of the workshops. For conciseness, the next sections present the themes that are anchored within the data and all supporting illustrative quotes are presented in Tables 2–4.

3.1 Theoretical framework of acceptability (TFA)

Six constructs of the TFA were coded through the interviews with the children and the teacher-specialized education

TABLE 2 Illustrative quotes of the construct of acceptability within the children and teacher interviews.

TFA construct	Illustrative quotes
Affective attitudes	"Well, I found it really fun" (Student) "I was really comfortable for sure" (Student) "Well, I would like to redo it all again with you!" (Student) "At the time, the children were very, very calm, much more than usual when they were doing their workshop there, if I can call it that, whatever it was; Lego or drawing or all that, I found that this time of day was much quieter than usual." (Teacher) "You know, when they saw that Friday they had the art-intervention, they were like 'yay they are coming, it will be fun'." (Teacher) "You know, for me it was just really super. […] I would 100% recommend the program!" (Specialized education specialist)
Burden	"Well, we talked about it, I really liked being more of an observer of my students. Which I can do like, never, because I'm always planning the activity, leading it, and then, support them while they do the activity. And then [with the art activities], given that I wasn't planning anything, it was even a surprise for me when… you know, I saw at the same time as the students what you were asking them to do. And I was really more in the position of an observer, and I really liked that. And you know, we know our students very well, but there are still little things… Sometimes I was like, ah ok!" (Teacher)
Intervention coherence	"It was that there were no expectations necessarily at the end… It was just to create freely." (Teacher) "I have nothing negative to say honestly, your animation was great, it was very simple and instructions too. It had to be simple for our clientele of students, you know reformulation to their needs…" (Teacher) "The choice of activities was really adapted to them [the students], I think they all had their favorite moment. Some really liked the dance, others it was more the Lego, so everyone say their favorite moment." (Teacher) "Well, it was really clear [what to do]" (Student) "I understood everything." (Student) "Because I'm used to drawing uh… to drawing well, and it was really hard [to do an ugly drawing]." (Student) "It took them away from their school routine to do arts… you know, have something different." (Teacher)
Ethicality	"You know, it's not… well, it's not in our mandate… Yes, we have to ensure their well-being, the students, but it's not in our mandate, you know, to check everything that's… their emotions in depth, all that. You know, the purpose of school is really to educate, to socialize, and then to help them learn, and in this way, you know, we learn more about our students, but at the same time, you know, it lets them express things they don't normally have the chance to do in class. I thought it was really good to put that into… I think it's great to do that in a school" (Teacher) "Well, you know, I was already comfortable dancing because I used to do it. I'd been doing it since I was little and since I was older. Play-Doh, well also when I was little, well I practised, I like it, it, it… well, I like it" (Student)
Self efficacy	"It was easier when I had an idea [of what to create] right away…" (Student) "You know sometimes if we show an example at the beginning, well they will tend to reproduce it without really thinking about it. So, I found that good because you didn't show, you know your creation first, you know, *here's my family,* because I think the results would have been biased a little or they would have wanted to reproduce what you would have done, so that's a plus to just give the instructions but without setting an example." (Teacher) "Well, you know, at the beginning, in the activities, for you to have an example that you had done… but it was also ok because at the same time, it proved to the students that it doesn't matter, I can do it like that, and I like it like that. But it's okay to go with your creativity because you know, if I remember correctly, for the self portraits, you know, they were looking for all the colors, really… But, you know, if you had made an example of well, lots of colors, something funky, you know and tell them: "me in my body, I feel, full of colors, so I put lots of colors", well it's… at least maybe they could have been like "Well ok, I can add yellow and orange and green… it'll still be beautiful." (Teacher)

TABLE 3 Illustrative quotes of the construct of feasibility within the children and teacher interviews.

Feasibility construct	Illustrative quotes
Time	"It took about one or two periods for the students to get to know you and feel comfortable. After they got to know you, they got into a kind of routine, and it was better then" (Teacher) "I would not have done less than one hour; we wouldn't have had time to really do the workshop." (Teacher) "Your preparation time at the beginning was fast, you were really ready." (Teacher) "I think that at the end we didn't really have the time remaining to share the projects [I would suggest] 10–15 min of discussion. It leaves less time for creation, but at least 10 min." (Teacher) "[It was a challenge for me to] have enough time to finish." (Student)
Practicability	"I think that being in the classroom helped them to continue to flourish because when they change their environment, sometimes there is a blockage, but in class, they just felt that something else was happening in their environment, and they let themselves go there." (Teacher) "Yeah, but I think that by doing it in their class, we really saw more of the true version of the students than if we had taken them out, brought them to another room, I think that there could have been students who would have been perhaps more reticent or in observation of what is happening around. Here [in the classroom], it was really like… in their environment, at their desk, with what they know around them, I think that helped them." (Specialized education technician) "I found it [the intervention] very suitable for the environment of our class. You know, because they all had language disorders that were expressive but also receptive, the side of… your explanations and the use of the material, I found that really great." (Teacher)
Material	"The material was on the table, and you know, you just had to give your instructions and then the students could begin… No, I have nothing negative to say". (Teacher) "Maybe the modeling clay, the fact that they couldn't mix the colors… Maybe there's that, yeah… It complicated the project a bit because you know, they couldn't push on it to make it hold, so that it would be more solid, so sometimes it would fall. They had to find a way to make it fit without sticking it…" (Teacher)
Ease of implementation	"The students knew what to do, the equipment was provided, they were motivated…" (Teacher)

technician pairs, as well as the focus groups and observation notes. Results are summarized in Table 2 with quotes supporting the acceptability of the art-based intervention from both perspectives. The construct of opportunity costs of participating in the intervention was not identified in the interviews nor the observational data and thus is not presented. Furthermore, the perceived effectiveness construct is integrated within the theme of the perceived mental health implications of the intervention (Section 4.3).

3.1.1 Affective attitudes

This construct reflects how the children and teachers/specialized education technicians felt about the intervention. In general, children had positive attitudes towards the art activities. They enjoyed the various mediums proposed and looked forward to the weekly activities. Students mentioned having fun and feeling happy during the intervention. Observational data also highlighted how the children seemed involved and comfortable as they were making art or sharing their experiences. Two

TABLE 4 Perceived mental health implications of the art-based intervention.

Mental health construct	Illustrative quotes
Emotional expression and regulation	"[art can be used for] expressing yourself a bit, like you know, some people express themselves through drawing, some through activities, some through dancing, stuff like that, but for me, to really express myself, you know when you're quiet, and you're sad, stuff like that, you can't talk about it with anyone, well, I draw all the time to take my mind off things… For me, it's… it's nice to draw and do activities with you. (Student) "[The art activities helped] To control my emotions a little, sometimes… I have a lot of anger… A lot of other stress and all that… I'm not able to control myself but it made me control my emotions more. […] I don't really know [how the activities helped that], but it was when we did an activity like Play-Doh, dancing, anything, well it I wanted to do it, but, if we didn't want to do it, we didn't… it was not obligatory, but really the activities were amazing!" (Student)
Feeling challenged	"The [ugly] drawing [was a challenge] because I always apply myself, but then, it made me feel good to draw a little bit whatever." (Student) "I found it extraordinary to see this student dance when he is usually scared to raise his hand to speak up during class." (Teacher) "We saw some students that it [dance] destabilized them, but they still participated, so it pushed them to go a little further than what they are perhaps capable of doing or that they were holding back on certain things… Butt then, it was letting go, given that it was in a context like a workshop with you, the two of you who were there…
Autonomy	"[art can be used for] expressing yourself a bit, like you know, some people express themselves through drawing, some through activities, some through dancing, stuff like that, but for me, to really express myself, you know when you're quiet, and you're sad, stuff like that, you can't talk about it with anyone, well, I draw all the time to take my mind off things… For me, it's… it's nice to draw and do activities with you." (Student) "To just build something, well they really needed help from adults. So, it's certain that I imagine that the more we do it, the more you know, they are able to go back to certain memories or just build something with an idea in mind, reproduce it, come out a little to put it visually, because yes they think about lots of things, but to put it on paper, on Lego, on in movement… It's more… it's more complex, than they are used to, you know, working, with words, with numbers, but going like… yeah, finding ideas, memories, emotions… I think it makes them more autonomous after that, to perhaps come and express themselves, and recognize their needs or their feelings." (Specialized education technician)
Competence	"In a way, it [creating art] increases their self-esteem, and we have several in class, you know, whose self-esteem is really, really low, but to do something like *Well, I managed to put into images what I was thinking, and it's beautiful, I've succeeded*, well, listen, it makes them feel much more competent." (Teacher) "Ok, well let's say I take [names a student], it's difficult for her to talk about her emotions, so do art therapy, and build herself out of Lego blocks or make her safe place, I find that it was easier for her because she used creativity, and she's super creative so that was really a plus." (Teacher) "[I feel] More capable of making Lego" (Student) "Interviewer: Can you give me an example of an activity that made you feel competent? Student: The dance!"
Relatedness	"Well, it was fun, all the friends participated at the same time… You were there, you know, I felt at ease" (Student) "For me, it's pleasant, and you know, it's fun to do activities like that with other people, and things like that, because it's true that it's boring when people don't participate… So yeah, it's fun to participate together." (Student) "When did they made a semi-circle and had to stand up… oh to go do their choreography! Through the eyes of others, to see a smile, I think to really have everyone's eyes on their own person, well I think that that can actually help to feel connect… because yes, they are sitting in the class, yes, we experience moments, we do workshops, we have, we have lots of varied things in the class, but that's it, they were like under the spotlight, if I can say so. Then to be applauded, to be complimented: "Wow, what you did is beautiful, how did you think of that? » You know, that's it, it can just come, awaken lots of beautiful things in them." (Teacher) "Yeah, you know, it's saying *Well you know, I made my family, but my family doesn't have many people because,* a bit like [names a student], *but I'm in a foster family, So, my family doesn't count in that.* Well, for her, it's difficult, but to say like, *I made my big sister because she's my only family*, well at the same time, she opens up to others to say: *me, this is my reality, and it makes me experience emotions*. To have this openness, it creates a connection, to be vulnerable around other people who are also vulnerable in fact." (Teacher)

students discussed that having the activities in their group with peers they already knew made them feel particularly comfortable from the beginning. Teachers mentioned that the class was remarkably calm and absorbed in the creative process. This state of ease in the classroom made teachers embrace the creative arts experience. Both teachers and specialized education technicians felt particularly grateful that the art created space for them to learn about their students. Many children and teachers spontaneously mentioned that they would redo the activities because they added value to their weekly routine.

In general, students enjoyed all the activities. When asked what their favorite activity was, no one activity nor medium emerged as a clear favorite. Many students mentioned liking all the activities and having difficulty choosing just one. Similar patterns emerged for the least enjoyed activities, with a few children identifying the dance activities as a challenge. This was not surprising, as the observational notes confirmed that it took over 10 min for the students to start feeling at ease during the dance workshops. However, the children mentioned that they overcame this challenge and felt proud of themselves for letting go of potential embarrassment. Observational notes also highlighted how, after this 10-minute mark, students seemed to let go and ease into the activity. Noteworthy, dance workshops were particularly appreciated by the teachers and specialized education technicians who said that they could observe their students "come out of their shells." The most reported words describing the general experience of the art-based activities were *fun*, *cool*, *enjoyable*, and *loved it*. No neutral or negative affective attitudes towards the intervention emerged in the interviews.

3.1.2 Burden

The construct of burden refers to the perceived amount of effort required of the participants to participate in the intervention. Burden was infrequently identified in the interviews. Instead, the teachers and specialized education technicians all mentioned how having a period of art creation allowed them to take a step back and observe their students from a different perspective.

One teacher mentioned that they often feel overwhelmed by the curriculum and thus chose to concentrate on academic and didactic priorities. However, they also reported feeling responsible for attending to their students' psychological needs and promoting their psychological well-being but did not feel they had the time

or resources to do so. For them, observing a novel and accessible way to discuss emotions through art, removed some burden associated to caring for the psychological well-being of their students. As per the quote in Table 2, one teacher even mentioned having started to use drawing techniques when a student was having a hard time expressing themselves. Overall, the intervention was not perceived as giving rise to a burden; rather, it facilitated verbal expression and gave the teachers tools to explore emotions with their students. Importantly, there was no harm observed by the facilitators nor reported by the students, teachers, and specialized education technicians.

3.1.3 Intervention coherence

The construct of intervention coherence refers to the extent to which the participants understood the intervention and how it worked. Observational notes indicate that the children had considerable experience with art-making. Many mentioned taking dance classes, making Lego at home, and enjoying drawing in class. The particularity of art-making in the context of this intervention was that it did not aim for a finished piece but rather to embrace the process of creation. This concept was rather well understood by the students, while some mentioned feeling frustrated at times being unable to finish their creations. However, participants were generally able to let go of their expectations. Further, when asked if the instructions were clear, all participants mentioned that what was expected from them was always well explained and explicit. This also stood out in the observational data, as children always went right into the creative process after the instructions were provided and created meaningful pieces using the art medium provided.

Teachers understood the intervention well, mentioning some key concepts during the interviews, such as the importance of creating a space without expectations, in order to create freely. Further, both teachers and specialized education technicians said the instructions were very clear. They appreciated that these were simple for their students, who generally found instructions complicated and difficult to understand due to their language difficulties. Instructions were at times repeated or rephrased to allow for better understanding, which teachers also acknowledged as important and well-conducted. Furthermore, teachers also appreciated the opportunity to break their students' routines and offer workshops that did not aim to enhance academic learning directly.

3.1.4 Ethicality

The construct of ethicality in the TFA framework refers to the extent to which the intervention fits well with an individual's value system. The present art-based intervention seemed well suited to the teachers' and specialized education technicians' values to integrate emotional expression and awareness in the school. Teachers and specialized education specialists were particularly grateful that a safe space was created, and that sufficient time was put aside to do this, as they reported often feeling rushed in their daily routines to do so. Thus, the art intervention put into action the teachers' value to integrate emotions in the classroom. Further, art-making was observed to be rooted in the children's interests. They mentioned many times that they had already made Lego, sculptures, drawings, and dances, indicating that the intervention included activities that were accessible. Overall, the intervention seemed to be suited to the school, the teachers', and the students' values, keeping them interested and making the emotion-based art-intervention meaningful to them.

3.1.5 Self-efficacy

The construct of self-efficacy refers to the participant's confidence that they can perform the behavior required to participate in the intervention. Observational data indicates that participants not only engaged in the art-based activities, but that they were also able to create within the suggested themes. Some participants initially struggled with finding ideas, taking their time to choose what they wanted to represent with their creation. These students requested support from the facilitators or their teacher to talk through ideas and validate the ones they might choose to create. One teacher suggested that in order to foster self-efficacy, examples could be provided to show the potential of creation within each medium and each theme. However, the other teacher did not agree, as the students tended to copy the example instead of applying the theme to their experience. Factors that seemed to facilitate self-efficacy included having age-appropriate instructions, using art mediums children were already comfortable with, and giving individual support when needed.

In summary, the perceived acceptability of the intervention relied on positive affective feedback throughout the intervention, no perceived additional burden, a good understanding of the intervention, a good fit within the school context and feelings of self-efficacy.

3.2 Feasibility framework

Content analysis of the interviews, focus groups and observational data revealed the four categories from the TFA. Each is presented below and in Table 3 with the supporting quotes from the interviews.

3.2.1 Time

The concept of time can be important in the school context because the schedule needs to be respected: the intervention had to be conducted in the right amount of time, which was a 50 min period. This relates to allowing enough time for art-making as well as keeping all children interested and active. Teachers agreed that a one-hour period was the right amount of time to conduct each workshop (introduction, instructions, art-making, discussion, clean up). However, one teacher suggested that more time should be allocated to the discussion period and sharing the art. Indeed, the discussions lasted between 4.70 and 11.58 min (mean discussion time = 7.26 min), and observational data confirms that these were sometimes shortened owing to a lack of time. The teacher mentioned that the art-making could be done in 40 min, allowing a 10–15 min discussion. Observational data suggests that most students would finish their pieces in 45 min. One student mentioned in the interview that they did not feel like they had enough time to complete the Lego sculptures.

Relevant insights from teachers include the importance of allowing a week or two for the class to feel comfortable with the first author and the research assistant leading the workshops. This was also observed during the session, whereby the students felt more comfortable sharing their art by the third session. This was particularly obvious when comparing the first and second dance workshops. The children were shy during the first dance workshop (week 2), especially for the free dance and improvisation components. They would do minimal movements and look at others and the adults for approval. They were much more comfortable by the second dance workshop (week 5), allowing bigger movements and exhibiting increased confidence. Hence, a recommendation might be to consider moving the first dance workshop later in the intervention to allow this confidence to be built.

3.2.2 Practicability

The concept of practicability refers to elements indicating whether the intervention was doable from the perception of the students, teachers and the people leading the intervention. Observational data suggested that the intervention plan was well followed and was not changed at any time. The activities were all conducted in the intended way and did not need to be further adapted. Both observational data and teachers/specialized education technicians interviews indicate that the intervention was easy to deliver, as the activities were well explained and well understood. Teachers also mentioned that using the classroom to complete the activities added to the intervention's practicability. As the quotes in Table 3 highlight, teachers and specialized education technicians believed that students were more comfortable in their classroom environment, making the implementation easier. Furthermore, the practicability of the intervention was also established by having researchers lead the activities. Teachers mentioned that having nothing to prepare was particularly appreciated, as their schedules were already full. In summary, the intervention implemented in the classrooms and facilitated by the first author and a research assistant was doable.

Furthermore, regarding practicability of the intervention, teachers recommended that parents be further informed and included in future iterations of the project. For example, one teacher suggested that the children's art be shared with the parents either by email or with a printed picture. They highlighted how this could create a space to further discuss these themes at home and practice communication through art with parents.

3.2.3 Materials

Materials were a core component of this art-based intervention. The researchers brought the necessary materials for the scheduled activity each week. These included Play-Doh, Lego, pipe cleaners, scarves, soft balls, and crayons. The materials were set up at the teacher's desk for the class to come pick up during the activity. Students could hence pick their colors, shapes, or other attributes of the materials provided to them. Observational data suggested that students were excited to be able to choose their colors, and this added to their feelings of creative liberty. Teachers also mentioned that the materials were suitable for the class. One of the challenges observed was that the different colors of Play-Doh could not be mixed, making the sculpting difficult at times. This decision was made so that colors could be reused in the other classes and the different activities. Nonetheless, one teacher suggested that one color be given to each student and that they make their sculpture with that color only. This challenge did not emerge from the interviews with the children, and the observational data suggests that sculpture solidity issues were overcome with the use of other objects, such as cardboard. In summary, the materials used in the intervention seemed to be appropriate, easy to use, require little setup and cleanup costs, of good quantity and well organized.

3.2.4 Ease of implementation

Ease of implementation relates to how the intervention was applied in the school context. This concept was closely related to the practicability of the intervention, as teachers greatly discussed the implementation in their school context. As previously mentioned, teachers highlighted the fact that outside researchers came into the class to facilitate the art activities made the implementation effortless for them. They repeated that they appreciated not having to prepare the activities and having the space to observe their students in a different context. Further, observational data highlights that the overall implementation went smoothly. The classes were ready to welcome the researchers at each of the reserved periods, the students were prepared for the activities when the facilitators arrived, the participants understood the instructions, and the art-making was executed within the desired parameters (i.e., although there were no expected outcomes, the children all made a meaningful piece of art that represented the theme of the week in their own way). The chosen themes were relevant to the students, as they elicited positive reactions, were a stimulus for mental health conversations, and enabled the creative process. Only one student was not able to let themselves make something scary, even if discussed with the facilitator and the teacher. This student's teacher mentioned in the interview that this was coherent with this student's attitude in class and their limits. In this case, the facilitator suggested the student did something that could be scary for someone else, and the student was able to let themselves create something within these parameters. Overall, the intervention was well implemented in the school context, given the facilitators' preparedness and past experience leading activities with elementary school children and the teachers preparing the classroom.

In summary, the interviews and observational data suggest that this intervention was feasible in the school context as the time constraints were respected, the intervention was doable, the facilitators brought the materials, and the context allowed a smooth implementation.

3.3 Mental health implications

Thematic analysis yielded the overarching theme of the mental health implications of the intervention. The sub-theme of creative exploration emerged as being related to these perceived benefits. Creative exploration was defined as using art and creativity to

explore emotions, thoughts, themes, and ideas about the world. This led to perceived changes in children in the domains of the self and with others in the classroom setting. Both these sub-themes are discussed below and supporting quotes can be found in Table 4.

3.3.1 Creative expression and the self

The first sub-theme that emerged from the data was the theme of creative expression and the self. Notably, the categories of perceived changes included enhanced emotional expression, as well as changes in feelings of competence and autonomy.

3.3.1.1 Emotional expression

Given their SLCD, verbal emotional expression was difficult for most of the children. The teachers noted that having another medium to express their emotions helped many children open up. Notably, one extremely shy participant was able to discuss their fear of monsters by sharing their artwork during the focus group. As discussed above, the teachers mentioned that they learned a lot about their students throughout the intervention. For instance, they learned about their students' families and fears, as children were able to articulate these through the creative process. Teachers and specialized education technicians mentioned that they would have never known about these experiences or emotions otherwise. Student responses from the semi-structured interviews revealed that many felt an increased ability to express themselves in class by voicing their ideas and opinions. This also related to the feelings of autonomy, as participants felt an increased sense of space for their ideas and emotions, as supported by the quotes in Table 4.

Observational data also suggests that children expressed feelings through their art in relation to the weekly theme. Further, in the focus groups, students could articulate their feelings verbally, mentioning how they felt during the art-making, and identifying how they felt related emotions in their body or what caused these emotions to emerge.

3.3.1.2 Feeling challenged

Teachers reported the children's ability to go out of their comfort zone, mainly during the dance workshops. One of the teachers mentioned that they were impressed by how the children took a risk and danced in front of their classmates. They also noted the challenge students faced when expressing a particular feeling with a movement. One of them mentioned that: "even for me, I was like, oh boy, how am I going to express my emotion in a movement?" The teachers also mentioned that some of the children seemed destabilized by the dancing activity, but still participated, which took courage on their part. One teacher expressed how impressed and amazed they were by one student during the dancing activity: "I found it extraordinary to see this student dance when they are usually scared to raise their hand to speak up during class."

Although some of the activities (e.g., dancing emotions and creating something scary out of Lego) presented challenges to several students, they were able to overcome these. For example, when one student was asked whether they experienced any difficulties during the activities, their response conveyed a desire to learn from these. Moreover, two students cited the "ugly drawing" activity as the most challenging given that they had become accustomed to drawing aesthetically and caring about the visual outcomes of their artistic endeavors. One of these students reported that this activity was challenging; however, the second observed that "it made [them] feel good to draw a little bit of anything." Hence, this student was able to experience a pleasurable feeling that arose from their willingness to venture out of their comfort zone by wholly engaging in the "ugly drawing" activity.

3.3.1.3 Autonomy

The concept of autonomy emerged from the interview with the teachers. One of the teachers mentioned that being autonomous was an issue for several students. Many of them relied on their teachers to find ideas of what to create, as well as express their thoughts and emotions. Teachers' discourses indicated that children had little space to experience a sense of volition in the classroom. Hence, at the beginning of the intervention, some students required help to identify their values, interests and beliefs that may drive their choices. As the intervention advanced, they embraced this space of choice in creating their artwork.

Observational data suggests that some children felt the liberty to be themselves and to create volitionally according to their values to be overwhelming, as they asked many questions and took a long time to start their creation. For others, autonomous decision-making was welcomed, and they would jump right into the activity. As the intervention progressed, it was observed that fewer students would ask for support in the decisions related to what to create. The concept of autonomy was observed when children chose what art they wanted to create, the colors they preferred, and how they would represent what they had in mind. Students' interviews reference increased feelings of freedom in being their authentic selves, as they felt the liberty to express what they wanted and how they wanted to express it within the parameters suggested by the workshop activity.

Furthermore, the art-making process allowed some participants to express and externalize their emotions. For instance, one student found that engaging in arts and crafts enabled them to express themselves and their ideas better. Moreover, another student mentioned how feelings of joy surfaced following the weekly art activities. They subsequently mentioned that they felt free to be themselves in the context of these activities and their classroom. Children discussed emotional expression concerning feeling free to be themselves in the presence of others. Further, observational data suggests that the artistic process enabled children to work through differences and insecurities, facilitating their emotional expression in the presence of others and ultimately allowing them to be the most authentic version of themselves. The teachers noted that the children could use their creativity to make art that represented how they felt, which facilitated working through difficult emotions or themes.

3.3.1.4 Competence

The concept of competence was tightly linked with a sense of accomplishment and self-confidence. As opposed to the usual

academic activities (e.g., languages, math), teachers and specialized education technicians mentioned that the art-making process did not require a right or wrong answer, leading the children to use their creativity to initiate work without any performance-related considerations. Data from teachers and observations also show that children were proud of themselves and wanted to share their creations with their classmates and teachers. As one teacher mentions:

> In a way, it [creating art] increases their self-esteem, and we have several in class, you know, whose self-esteem is really, really low, but to do something like "Well, I managed to put into images what I was thinking, and it's beautiful, I've succeeded," well, listen, it makes them feel much more competent.

Most student responses about competence related to improved abilities in specific art activities. For instance, one student explained how, by practicing and observing other students, they could improve their drawing skills. Similarly, another student stated they felt more competent in art activities involving drawing, Lego, and play dough. Overall, the students felt they could gain a sense of mastery, especially as there were two different sessions involving the same medium. As for dance, observational data showed that the children were rather shy and closed off at the beginning of the first workshop exploring this medium of expression. However, by the end of this first period and throughout the second dance workshop, students became more at ease and let themselves explore various movements. This was related to feelings of pride; for some, this medium of expression was both the most challenging and the most appreciated. Overall, children's discourse, teacher/specialized education technicians and observational data indicate that art-making was related to perceived feelings of competence in some students.

3.3.2 Creative expression with others

The second sub-theme that emerged with regards to mental health was creative expression with others. This referred to the experience of relatedness brought by the creative process and the discussions.

3.3.2.1 Relatedness

Students' feelings of relatedness with others appeared to be related to their motivation to participate in the art-based activities and were indicative of their level of comfort during the activities. This became apparent when one student partially attributed his incentive to engage in these activities to the fact that he had "fun with his friends" while doing so. Similarly, another student ascribed their pleasurable experience of the creative workshops to the act of "participating all together" and enjoying joining in activities with the full classroom (including, but not restricted to, their friends). Other students specifically expressed that knowing those who surrounded them during the art-based intervention enabled them to feel at ease. In sum, the data suggests that creating art in a group increased the students' perceived feelings of comfort, potentially inciting greater emotional expression.

Furthermore, one teacher mentioned that students opened up during the group discussion and seemed more welcoming of the experiences of others. They discussed how the intervention made the children interact throughout the group discussions and were impressed by how open the children were with their classmates. This was also apparent through observational data that noted that children would react positively and supportively when others would share their art, reflecting on similarities and differences, as well as general appreciation.

Teachers also noted a fear of being judged that was an issue during some activities, notably the dancing activity. However, all students took the opportunity to experiment with dancing at their own pace. Throughout the intervention, the children gained confidence and let go of their fear of how others would perceive them. Teachers reported that it took courage to be under the spotlight and to share their experience and creations. It was also gratifying for children to get applauded and complimented for their art creations. Observational data further highlighted that student interactions were positive, accepting, and supportive. When asked how art activities could help in school settings, one student responded that it could assist students with less verbal fluency or second-language speakers in expressing themselves. This suggests that students taking part in the art activities were accepting of others and recognized the value of artistic interventions in facilitating the integration of all students in their classroom.

4 Discussion

The present study aimed to explore the acceptability, feasibility, as well as students', teachers', and specialized education technicians' perceptions of the benefits of an 8-week school-based art intervention aimed at supporting the emotional well-being of elementary school children living with SLCD. The overarching themes were those of the perceived acceptability of the intervention within the TFA, the perceived feasibility, and the perceived mental health implications.

4.1 Acceptability and feasibility

Overall, the findings suggest that the school-based creative art intervention was acceptable and feasible for children experiencing SLCD. Notably, components of the interventions that reinforce previous findings regarding school-based interventions include using age-appropriate approaches (54), reiterating that the goal of art-making is not the final art piece but the process itself (55), allowing enough time for discussions through the art (56), and choosing a variety of accessible mediums to discuss emotions (57). The results also indicate that the intervention was not perceived as a burden in the classroom. To this point, it is essential that interventions integrated into the classroom avoid teacher burnout (58). Further, one of the main goals of an acceptability and feasibility study is to determine if further testing should be conducted (43). These findings indicate high levels of these two constructs. Paired with support for the intervention from the students, the teachers and specialized education technicians, this suggests that the present intervention should be further evaluated using experimental methods. Finally,

the results also indicated that more time should be given to discuss the art creations after the workshop. This element is essential to the process of change during art-making (56) and should be better integrated into future studies using art-based approaches.

4.2 Self-expression and the creative process

Although this study did not quantitatively measure the impact of the art-based intervention on the well-being of children with SLCD, perceptions gathered from students themselves, their teachers and specialized education technicians, as well as from the observation grids, tend to support the fact that the intervention facilitated self-expression, fostering self-confidence and creativity. As discussed previously, students initially felt challenged to express their emotions. However, the intervention—and the safe space created in its implementation—encouraged them to share their emotional and internal worlds through their artwork. This approach enabled them to feel more capable of expressing themselves, particularly because there was no concept of a "right" or "wrong" way to participate, which helped develop their perceived confidence, competence, and pride in themselves. These findings align with previous research highlighting the benefits of art-based interventions for individuals who have difficulty expressing themselves verbally (21, 22). Indeed, a study with preschool children with communication difficulties reported similar results, where movement, visual art-making, and theatre provided a space to communicate emotions in these younger children (12). These art-based activities in turn, reduced anxiety in children and increased their empathy (12). It thus seems that art-making could foster the emotional expression of children with SLCD within the classroom. To this end, parents of children with SLCD have expressed the need for mental health interventions that do not rely on verbal communication (59). It appears that art-based interventions could potentially serve this purpose.

While some students initially expressed frustration at letting go of perfectionist ideals, this challenge represented an opportunity to step out of their comfort zones and relinquish the notion of an aesthetic final piece of art. Since the focus of the activity was more on the creative process than the final creation, children with SLCD were freed from these expectations. They could concentrate on self-expression and enjoying the activity. This ultimately made them more comfortable expressing themselves and gaining confidence in their artistic abilities, as emphasized by various other studies (21, 22). Introspection and self-expression are fundamental to the therapeutic process of art-making, as this is believed to be a mechanism of change by which art-making can support mental health (60). However, this process of introspection and self-expression through art might not be accessible to children in all contexts. An approach that may be beneficial when young people are hesitant to open up to the creative process is philosophy for children (P4C), which could be useful to encourage young people's questioning about the work they are asked to create, thus enriching the creative process itself (61). Within the creation of art, combinations with P4C would make it possible to explore reluctance linked to performance anxiety (e.g., discussing what beauty is) and the fear of the gaze or judgment of others (61). It could therefore offer children a space to explore their doubts related to the creative process. In doing so, adding a P4C component would act as a catalyst to carry out artistic activities. Our own research suggests that combining P4C and other approaches may increase its benefits, as it helps children create meaning from their experiences while supporting their self-determination (62).

4.3 Basic psychological needs satisfaction

One of the most salient results from this study lies within perceived changes in satisfaction of the basic psychological need for autonomy in students, which can be linked to increased self-expression. Indeed, children reported that the freedom to express themselves authentically through their artwork, along with the absence of pressure to produce something aesthetically pleasing, contributed to building a stronger sense of self and to their feelings of acting volitionally, in accordance with their true self and thus in a more self-determined manner. While the need for autonomy is often referred to as an internalized and relatively hard-to-observe need (63), the fact that teachers and facilitators observed these changes could indicate that this was an essential aspect of the intervention. Interestingly, this diverges from other studies suggesting that teachers may not be the best proxy to identify changes in their students' autonomy (64). Future research should investigate in what situations teachers or parents could provide valid evaluations or observations of changes in the satisfaction of autonomy in children. Furthermore, offering a variety of materials with which to create and sufficient time to do so allowed students to select what resonated with their thoughts and their envisioned creation, thus encouraging their autonomy.

Although a distinct concept from autonomy, self-confidence can contribute to feeling more autonomous and competent (65). Noteworthy, previous research evaluating the impacts of art-based interventions on mental health has also shown that artistic creation can enhance self-confidence in children (66). Other initiatives, such as the YouCreate program, have highlighted the essential role of the creative process in the journey towards self-discovery, self-expression, and acting in coherence with one's values (67). Further, children with emotional and behavioral difficulties who participated in school-based dance and movement psychotherapy reported that it encouraged self-expression, emotional regulation, mastery and acceptance of emotions, improved self-confidence and self-esteem, reduced stress, and helped develop positive relationships; all of which are essential in feeling self-determined, competent and affiliated (68).

Moreover, art-making promoted a sense of trust between students, their peers, and their teachers, thus contributing actively to the satisfaction of their need for relatedness. This echoes other research that found that an art-based intervention could increase empathy and connection between preschool students (12). Indeed, fostering a safe space for students to share their emotions with their teachers can positively impact their relationships. Many studies highlight the benefits of positive

student/teacher relationships in students' academic, behavioral, and social-emotional spheres (69–71) and consequently on the satisfaction of their basic psychological needs (72). Moreover, because the art intervention occurred within a group setting, it facilitated active participation and the development of social skills. Some participants mentioned how the activities also mitigated the language barrier challenge across students, facilitating the affiliation process. As a result, children felt more at ease expressing their emotions and being themselves in the company of others. These outcomes align with previous work based on self-determination theory, which emphasizes the role of relatedness in promoting psychological well-being (63). In this study, the sense of community and trust established through the activities nurtured a sense of security, authenticity, and belonging among the students, their teachers and specialized education technicians. This also resonates with literature on the importance of autonomy support in the classroom, which indicates that warm, supportive relationships could reduce students' anxiety and depression levels (73, 74), while also promoting better adjustment (75). As such, feeling connected to other students and their teachers through the art-making process, while feeling supported in their autonomy in doing so, could be mechanisms of change in art-based interventions (76).

Finally, students felt that art-making and emotional expression led to increased feelings of competence. Indeed, it has been shown that engaging in accessible, yet challenging activities can contribute to feelings of competence in children, as they can observe their skills improve. With appropriate support, children can learn skills that are just out of their comfort zone, a concept that has been named scaffolding in the zone of proximal development (77). Introducing activities that are "optimally challenging" allows students to test and broaden their abilities (78). Art-making specifically can be a way of offering this means of support to scaffold children's introspection and emotional expression (79). In the context of this study, children who typically had a hard time expressing their emotions were provided with a new way to articulate their feelings with the support of both the mediums used and the facilitators. Hence, art-making perhaps contributed to enhanced feelings of competence, not only in creating art but also in the overall emotional expression. Art-based activities are flexible approaches that can be well-suited to meet children at their unique developmental stage through the variety of mediums and themes (80) allowing for feelings of competence to emerge.

Overall, feedback from students, teachers, and specialized education technicians alike all highlighted how the intervention allowed the creation of a safe space for individual introspection and emotional expression in the classroom. This, in turn, facilitated creativity and authenticity in children. Further, concepts pertaining to familiarity and comfort were considered significant factors supporting the acceptability and feasibility of the intervention, as indicated in the TFA's intervention coherence and ethicality components. For instance, students mentioned that they had already engaged in similar activities at home, which made them feel more at ease (thus more familiar) when participating and expressing themselves emotionally in school. These findings align with previous research highlighting the need for educators to include non-academic elements, like emotional expression, within the curriculum (81). Taking part in the intervention reinforced teachers' conviction that it is important to consider their students' emotional well-being in their teaching while providing a resource to do so. Children have been found to thrive in environments where their social-emotional skills are nurtured, and they feel self-assured, relaxed, and secure (82). Thus, it appears that results from this study support the premise that art-based interventions could support the satisfaction of the three basic psychological needs for autonomy, competence, and affiliation, contributing to overall mental well-being in children.

4.4 Implications for teachers' well-being

Both students and teachers provided favorable feedback in terms of ease of implementation, time efficiency, and practicality. Teachers also expressed appreciation for the help of an external host overseeing the activities, allowing them to actively participate and engage in the process. They even reported indirect perceived benefits of participating in the activities on their own mental health. Although we did not plan the intervention with any benefits for teacher mental health, these results may hold promise. Indeed, it is well known that teachers often face multiple layers of stress that make them more vulnerable to burnout, mental, and physical health issues, as well as strain their relationships with students (83). Results from this study lead us to believe that developing art-based interventions, whether in individual or group settings, could be a valuable resource for teachers themselves and have trickle-down effects on their students. However, further research on this topic specifically is warranted.

4.5 Recommendations

One recommendation of interest raised by teachers was to enable the sharing of the created art with the children's families at home, to facilitate parent-child communication about school activities. Indeed, the research linking parental involvement and communication in their child's activities has established a clear causality with children's development, academic success, and emotional well-being (84, 85). Although many studies have explored the benefits of family-based art therapy, there exist no indications to our knowledge on the question of sending pictures of the students' creations to their parents/guardians. Ethical considerations raised by the research team on this topic involve obtaining children's consent before sending these pictures and the limited emotional support that could be extended at home. Indeed, the variety of family dynamics and realities may bring about unexpected challenges. Nonetheless, the benefits of using the created pieces to continue discussions, emotional expression at home, and their inherent ethical and practical issues, should be further explored. In the meantime, organizing an exhibition of the students' artwork after the intervention could serve to present creations to families and the community, drawing inspiration from photovoice research (86).

4.6 Strengths and limitations

This study counts notable strengths. It presents and integrates the rich perspectives of children and teachers on the effects of an art-based intervention on acceptability, feasibility, and mental health, through semi-structured interviews, focus groups and observational data. The qualitative design selected for this study allowed participants to voice their reflections on the process and the perceived benefits of the intervention and directly share their experience in their own words. Children's perspectives are often not directly taken into account in published research, while they provide valuable information about their lived experience (29). This is especially true in the context of art making. As such, a considerable strength of this study resides in giving them a voice about the perceived benefits of the intervention, while triangulating their experiences with other sources of data. However, like all studies that rely on participant self-reports, potential desirability biases may have been at play. Observational data and other strategies were used to reduce this bias (87), but it is possible that the children and teachers were biased in reporting their perceptions about the intervention. This may also have been brought about by the dual roles of facilitators and researchers, which could have hindered the expression of negative perceptions of the intervention. This was partly overcome by presenting an open attitude with a genuine desire to improve the intervention to benefit other classes and children.

Another limitation lies in the identification of the children with SLCD included in this study. Indeed, the diagnosis was given by the school psychologist, who would determine if the child was eligible to be in the special needs classroom. However, the researchers did not have access to these diagnoses and did not know the severity of the SLCD of the children nor the exact prevalence of comorbidities. Hence, the transferability of the results may also be compromised by this limited information about the participants. Furthermore, in the researcher's observation, the children had a relatively high level of verbal expression, and communicated with a wide range of vocabulary, as can be seen in the chosen quotes. These were representative of the language level of the participants. Most challenges resided in receptive functions and only required speaking loudly, articulating clearly, and repeating at times. Nonetheless, obtaining verbal information from the population of children with SLCD remained a challenge for this study and constitutes a limitation, as children were perhaps not able to express everything that they desired during the interviews. Body language and general reactions were noted in the observational data to allow for further understanding of the children's experience beyond what they expressed verbally. Several children asked questions during the interviews, asked for certain words to be defined or repeated, and expressed themselves when they did not understand questions. These problems were addressed by using different wording, allowing the children a certain amount of time to express their thoughts, and using reflection to ensure comprehension. Upon reflection, diverse strategies that go beyond verbal expression in the interviews could be used, such as drawing and miming techniques (88). Member-checking involves checking with the participants whether the results reflect their experience and seem valid or accurate. This approach could also be used with children in future studies to ensure accuracy of results, and whether these resonate with the participants' experiences to ensure the credibility of the results (89).

Furthermore, it is strongly recommended to continue evaluating factors associated with acceptability and feasibility over time, as some longer-lasting perceptions may be relevant (90). Implementing a longitudinal design would be recommended. Finally, the transferability or social validity of the present results remains limited to the specific population (children with SLCD) in a relatively small sample within a particular setting (elementary school in Quebec, Canada). The present school-based research had limited access to some information that could have given a better portrait of the samples (e.g., socioeconomic data). It is recommended to find ways to access and present this data without compromising the confidentiality of participants to gain a better portrait of participants. Future experimental studies, employing both qualitative and quantitative designs, are needed to better understand the extent of the impacts of art-based interventions on student mental health in elementary schools, specifically those with SLCD or in special education classrooms across various age groups, socioeconomic groups and for children with various comorbidities. Positive findings in the present work indicate that the intervention effectively addressed the needs of participants. However, the same intervention themes and mediums may not be relevant to all youth populations. Indeed, the adaptability of art therapy enables researchers to cater their approach to meet the unique needs of participants (28, 91). To ensure an intervention is culturally appropriate, it is strongly recommended to include community partners in the research process, particularly in the creation of an intervention (92).

5 Conclusion

The present study explored the acceptability, feasibility, and perceived mental health benefits of a school-based art intervention in specialized education classrooms for elementary school students with SLCD. Results from this study show a promising potential of art-based interventions to enhance the mental health and emotional well-being of elementary school students living with SLCD. The findings, derived from in-depth qualitative assessments encompassing the perspectives of students, teachers, and specialized education technicians, underscore the feasibility and acceptability of such interventions. All data sources converged on the tangible perceived benefits, including improved emotional expression abilities, along with heightened feelings of autonomy, relatedness, and competence.

These outcomes reaffirm the transformative power of creative arts in fostering positive self-concepts and facilitating constructive emotional outlets. The art-based workshops were perceived as safe spaces where students could share their emotions and gain a sense of accomplishment through the creative process. Additionally, teachers' newfound insights into their students' emotional experiences highlight the potential of art-based approaches to cultivate more empathetic and constructive classroom environments.

However, while this study provides compelling qualitative evidence, it is essential to recognize the need for further rigorous experimental studies to corroborate these findings and establish a robust causal link between art-based interventions and improved mental health outcomes. Nevertheless, the present research lays a strong foundation for future endeavors aimed at harnessing the therapeutic potential of art to empower and uplift children facing communication challenges in educational settings.

Data availability statement

The datasets presented in this article are not publicly available due to privacy or ethical restrictions regarding qualitative data. Requests to access the datasets should be directed to Catherine Malboeuf-Hurtubise; catherine.malboeuf-hurtubise@ubishops.ca.

Ethics statement

The studies involving humans were approved by the Bishop's University Research Ethics Board (102682) and can be contacted at: researchoffice@ubishops.ca. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

TL: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Software, Validation, Writing – original draft. CH: Project administration, Resources, Supervision, Writing – review & editing. ZM: Writing – review & editing. AM: Conceptualization, Methodology, Supervision, Writing – review & editing. KH: Formal Analysis, Methodology, Validation, Writing – review & editing. JP: Formal Analysis, Writing – original draft. MG: Writing – original draft. MB: Formal Analysis, Writing – original draft. KS: Formal Analysis, Writing – original draft. NB: Writing – review & editing. JS: Writing – review & editing. CM-H: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frcha.2024.1322860/full#supplementary-material

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Depression symptoms, communication and cooperation skills, and friendship: longitudinal associations in young Norwegian children

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Introduction: Symptoms of depression in early childhood have been linked to interpersonal difficulties, whereas friendships serve a protective function.
Methods: In the present study, we examined depression symptoms in preschool age (4 years) in relation to social skills (communication and cooperation), and friendships into early school age (Grades 1 and 2) in a large subsample (n = 943) of Norwegian children.
Results: The results indicated that preschool depression symptoms negatively predicted Grade 1 communication skills, which in turn predicted Grade 2 depression symptoms. This pathway suggests that communication skills may be a maintenance factor for depression symptoms in young children. In addition, preschool depression symptoms predicted lower Grade 1 cooperation skills, which in turn predicted lower Grade 2 communication skills, suggesting that preschool depression symptoms may begin a cascade of social skill problems that affect cooperation and communication skills into early school years. Best friendships were negatively related to depression symptoms in preschool and Grade 2.
Discussion: Given that preschool depression symptoms impact the development of social skills and friendships, it is important to attend to depression symptoms in early childhood.

KEYWORDS

depression symptoms, communication, cooperation, best friend, early childhood

1 Introduction

There is growing evidence of symptom-driven pathways of internalizing symptoms predicting social and emotional difficulties, such as problems with peers and further internalizing symptoms in early and late childhood and adolescence (1–3). Depression symptoms can occur as early as preschool age with young children showing similar symptom patterns (adjusted for age-appropriate expressions) as older children and adults (2, 4–6). Depression symptoms also show continuity into the school years (7, 8). Interpersonal difficulties (i.e., social problems) are strongly linked to depression

symptoms at all ages (9), while good interpersonal relations like friendships are protective (10). In the present study, we were interested in the longitudinal relations between depression symptoms in preschoolers and the development of social skills (i.e., cooperation and communication) and friendship across Grades 1 and 2.

Interpersonal models of depression suggest that relational processes relate to the development and/or maintenance of depression (11–13). For example, children with depression symptoms may engage in interpersonal behavior that others find aversive, leading to rejection by peers and/or adults, which in turn relate to subsequent depression symptoms (11–13). Depressed individuals may exhibit paralinguistic types of behavior that can interfere with attempts to communicate with others. In particular, they tend to have slower speech, say less, be quieter, and take more time to respond to the speech of others (9). Others rate the speech of those experiencing depression as less clear, and more difficult to hear and to understand than non-depressed individuals (9). These features may negatively influence communication with and responses of others. The actual content of speech also tends to be more negative in depressed individuals and negative self-disclosures more common, which have been linked with rejection (9, 11). Although much of the experimental evidence regarding paralinguistic behavior has been established in adults, depression symptoms linked to these deficits have also been shown to occur in preschool children (e.g., anhedonia, psychomotor agitation, irritability, cognitive impairment) (4).

Early school-aged children experiencing depression symptoms have also been found to be less social, spend more time alone, are more rejected by peers, and display more hostility (14, 15). Researchers have found that friendship is protective for those at genetic risk for depression symptoms, particularly for girls when friendships are reciprocated (10). This suggests that early depression symptoms may be a risk for later depression symptoms and that peer problems (7) and social skill development (9) may maintain symptoms over time.

Earlier theories of depression typically linked deficits in social skills to the development of depression symptoms (e.g., 16). More recent theories, however, note that what appears as a deficit may in fact be a lack of expression of a particular skill during a depressed state rather than an enduring deficit that is also present when depression symptoms are low (9). Interpersonal theories of depression posit that social-behavioral deficits and relationship problems are predicted by depression symptoms in late childhood and adolescence (3). This pathway has also been found in preschool-aged children, although less commonly examined (e.g., 2). The ability of a preschool child to respond in a socially competent manner can be compromised when high levels of negative emotions occur in their social interactions (17). High levels of negative emotions are common for preschoolers with depression symptoms (5). Emotional competence is concurrently associated with social competence in preschool age and longitudinally associated with social competence in kindergarten (18).

Deficits in social skills can be related to acquisition of the skill (acquisition deficits) or the ability to perform a skill (performance deficits), whereby the child knows how to perform the skill but chooses not to do so in certain settings or circumstances (19). Many social skills deficits are now understood as motivational problems rather than a lack of knowledge to execute the skill and, consequently, that performance deficits can arise when the skill has not been adequately reinforced (19). Two social skills that are particularly influenced by intervention programs are cooperation and communication (20), which are typically learned, practiced, and established through forming and maintaining friendships, and particularly having a best friend.

Depression symptoms already occurring in preschool may interfere with the acquisition and performance of social skills such as communication and cooperation. Preschoolers' depression symptoms can also influence their school-aged cooperation and communication skills. Conversely, poorly developed social skills may impact depression symptoms. Depression symptoms may also influence the ability to form friendships directly or have friends indirectly through poorly developed cooperation and communication skills. Having friends may further impact a subsequent improvement of cooperation and communication skills. Friendships are dyadic, reciprocal, and voluntary, and friends are typically the relationship that is most enjoyable and that matters most to children (21–23). By the age of 4–5 years, three-quarters of children have a close friend and can reliably identify a best friend (24).

Best friends are normally expected to spend more time and share more resources (e.g., support, intimacy) than other friends (22). Having a best friend in preschool thus allows for more positive social experiences and is a meaningful relationship at this age (25). Friendships in early childhood tend to center on common activities and concrete reciprocity (22). Children with higher depression symptoms generally have peer interactions of lower quality, including less cooperation (15), and their play partners often conclude that the depressed child does not enjoy playing with them (26). Negative content in conversation and unsolicited negative feelings also tend to occur more frequently in close relationships of those with depression, which are often expressed at times that are socially inappropriate, placing them at risk of not maintaining close friendships over time (9, 11, 27).

Preschoolers with better communication and cooperation skills are generally more accepted by their peers, whereas those who are withdrawn tend to be less accepted by the peer group (28), resulting in fewer opportunities to practice the skills needed to maintain friendships, including cooperation and communication (29). In fact, communication skills are core skills that underpin the development of friendships in early childhood and cooperation is a fundamental skill that helps establish and maintain friendships (30).

Despite the established links between depression and social competencies (and deficits) in childhood, there is a paucity of research examining the direction of association addressing early social competencies (e.g., having a best friend, cooperation, communication) and depression symptoms. Accordingly, we

explored associations between teacher-reported child depression symptoms and friendship in early childhood and school-age social skills and friendship. Specifically, we used a cross-lagged panel model (CLPM) to examine how depression symptoms were associated with cooperation and communication skills, along with having a best friend across early childhood in a large population-based sample of Norwegian children.

Parent internalizing (i.e., anxiety and depression) symptoms, early socioeconomic risk, child gender, as well as hours of daycare attendance were explored as covariates given that parental symptoms of anxiety and depression have been associated with children's depression symptoms (31), that gender differences in cooperation skills have been found for young children (32), and because the protective factor of friendship is suggested to have more impact on depression symptoms for girls (10). To account for these associations, we included the covariates as part of our model.

2 Materials and methods

2.1 Participants

Data were selected from the Behavior Outlook Norwegian Developmental Study (BONDS), a longitudinal study that began when children were aged 6 months ($N = 1{,}159$) (33, 34). Data used in the current paper were collected from parents, daycare teachers, and schoolteachers at the child's age of 6 months, 12 months, 4 years [$M_{age} = 50.28$ months ($SD_{age} = 1.44$)], in Grade 1 [$M_{age} = 77.56$ months ($SD_{age} = 3.34$)], and in Grade 2 [$M_{age} = 98.53$ months ($SD_{age} = 3.29$)]. Most children were in daycare at the age of 4 years (97.8%) and 5 years (98.4%). Most daycare teachers reporting on children at 4 years had the position of educational leader (80.5%) and had a preschool teacher education (81.8%), whereas schoolteachers reporting at Grades 1 and 2 had teacher training (i.e., post-secondary education). In Norway, children start school (Grade 1) in August, the calendar year they turn 6 years of age. Before formal schooling and starting from age 1, Norwegian children have access to universal and quality regulated kindergarten (i.e., preschool in North America), which is highly subsidized. Today, most toddlers and preschoolers in Norway attend kindergarten, including more than 97% of all children aged 3–5 years, and 85% of children aged 1–2 years (35). Children can be placed in kindergarten from the age of 1 until the summer of the calendar year they reach 6 years of age.

2.2 Procedures

Trained research assistants interviewed mothers and fathers in local offices or in their homes, if preferred. Although both parents were invited to participate in the first interview when their child was aged 6 months and at 48 months, due to limited resources and to reduce dropout, fathers were primarily targeted when their child was aged 12 months and in Grade 1 and mothers when their child was in Grade 2 [see Nærde et al. (34) for more details]. The daycare teachers who knew the target child the best filled out questionnaires at the daycare center when child participants were aged 4 years and the child's main teacher filled out questionnaires around December of Grades 1 and 2.

2.3 Measures

2.3.1 Depression symptoms

The ASEBA Teacher Report Form (TRF) (36) withdrawal/depression subscale (age 4 years: C-TRF 1.5–5; 10 items; e.g., "Shows little interest in things around him/her"; Grade 1 and 2: C-TRF 6–12; 8 items; e.g., "There is very little that he/she enjoys") was used to measure depression symptoms in young children. Items were rated along a 3-point scale (0 = not true; 1 = somewhat or sometimes true; 2 = very true or often true). The items were averaged to create a composite score of depression symptoms. Cronbach's alpha was 0.79 [95% confidence interval (CI) 0.77–0.82] at age 4, 0.75 (95% CI 0.73–0.78) in Grade 1, and 0.74 (95% CI 0.71–0.76) in Grade 2. Cronbach's alpha was in the range of 0.7–0.9 (37) and the lower bound of the 95% confidence interval was greater than 0.7 (38), which provide support that the reliability of the scales were likely acceptable. A validated Norwegian version of the TRF was administered to participants (39).

2.3.2 Cooperation and communication skills

Cooperation and communication in Grades 1 and 2 were measured using the teacher version of the social skills scale from the Social Skills Improvement System Rating Scales (SSIS-RS) (40), encompassing two of the seven included subscales. Items were rated along a 4-point scale (0 = never; 1 = seldom; 2 = often; 3 = almost always) and items were summed to form a composite score. Cronbach's alpha for cooperation (six items; e.g., "Follows classroom rules") was 0.88 (95% CI 0.86–0.89) in Grade 1 and 0.89 (95% CI 0.87–0.90) in Grade 2, and for communication (seven items; e.g., "Takes turns in conversations") it was 0.80 (95% CI 0.78–0.82) in Grade 1 and 0.83 (95% CI 0.81–0.84) in Grade 2. The Cronbach's alpha was in the range of 0.7–0.9 and the lower bound was greater than 0.7, suggesting that the values were likely acceptable. We used a Norwegian translation of the SSIS-RS by researchers at the Norwegian Center for Child Behavioral Development using a backtranslation procedure.

2.3.3 Best friend

Teachers reported on participating children's best friendship by answering the question: "Does this child have a special friend or best friend in kindergarten?" (age 4) and "Does this student have a special friend or best friend in the class?" (Grades 1 and 2) using response options of 1 = yes and 0 = no. These items were administered in their original Norwegian form.

2.3.4 Covariates

2.3.4.1 Parent internalizing symptoms

The 12-item short version (41) of The Hopkins Symptom Checklist (SCL) (42) was used to measure parental anxiety (e.g., Feeling fearful) and depression symptoms (e.g., Feeling of worthlessness) at age 4 for both fathers and mothers. Items were answered along a 4-point scale (1 = not at all bothered; 2 = bothered a little bit; 3 = quite a bit bothered; 4 = very much bothered) and averaged to form a composite score. Cronbach's alpha was in acceptable ranges of 0.88 (95% CI 0.87–0.89) for fathers and 0.90 (95% CI 0.88–0.91) for mothers. The SCL was presented to participants in Norwegian and was a validated Norwegian version (41).

2.3.4.2 Early socioeconomic risk and hours in daycare

Early socioeconomic risk was measured using a cumulative risk score calculated from socioeconomic status items from the ages 6 and 12 months on parent education and occupation, financial difficulty, housing conditions, and lone parent status (43). Specifically, low parental education [response options included: "9-year elementary school or shorter," "1–2 years of high school," "Higher vocational," "3 years of high school, upper secondary school," "College, university up to 4 years (Bachelor, Nurse, Teacher, Engineer)," or "University, college, more than 4 years (Master's degree)"] where at least one parent with 1–2 years of high school or less was classified as low parental education, at least one parent unemployed and/or on welfare or staying at home (response options included "occupationally active," "student or school pupil," "parental leave," "stay at home," "unemployed, looking for work, on measures," "social security, under rehabilitation"), having endorsed enduring financial hardship over the previous year [item: "Now there are some questions related to various strains" with a response option: "Finances (payment of rent, loans, obligations, and the like)"], endorsement of two or more of the following three housing conditions were classified as high risk: not owning a home, or a home with fewer than two bedrooms, or dissatisfaction with the home (item: "How many bedrooms and living rooms does the home have? (Living room of 6 m^2 or more, apart from kitchen, bathroom, hallway, laundry room)" where participants answered the number of rooms and "How satisfied are you with the home you live in?" with response options of "very satisfied," "satisfied," "dissatisfied," "very dissatisfied"), and the parents not living together or the mother being single, widowed, or separated from the father (response options included: "married or registered partner living together," "cohabiting," "single/divorced/separated/widow/widower"). A risk score was calculated for each item (i.e., high risk = 1 or low risk = 0) and summed to form a composite score in the range of 0–5. At age 4, parents were also asked "How many hours per week does the child spend out of the home (includes time in a day care center, and time with a babysitter)."

2.4 Analytic plan

Participants with at least one data point over time on each of depression symptoms, cooperation skills, communication skills, and having a best friend were selected for the analytic sample (n = 943; 81.4% of the original sample). A CLPM was performed in Mplus version 8.0 (44) with a weighted least squares (WLSMV) estimator due to the best friend items being dichotomous and endogenous. Models were evaluated using a comparative fit index (*CFI*) of 0.95 or above as adequate and root mean square error of estimation (*RMSEA*) of less than 0.08 as adequate (45, 46). The chi-square test was used as a fit indicator while considering the sensitivity to large samples (47). The WLSMV estimator requires the chi-square test to be calculated using the DIFFTEST option in Mplus to compare nested models only (44). Using this estimator, the least restrictive model is estimated first and then any model restrictions are compared to the overall model.

We began with an overall model (Model 1) including covariance paths within time point and stability paths across the same construct over time, as well as 1-year cross-lagged paths among depression symptoms, cooperation skills, communication skills, and having a best friend and covariates (i.e., early socioeconomic risk from birth to 1 year of age, parental internalizing symptoms at age 4, and hours in childcare at age 4) were included. In this model, gender, early socioeconomic risk, and parental internalizing symptoms were predictors of each of the variables in our model, whereas hours in childcare at age 4 was a predictor of the included variables at age 4 (i.e., depression symptoms and having a best friend). Covariates were allowed to be correlated. Although the Akaike information criterion (AIC) is typically an indicator of model fit related to non-nested models, this indicator was not calculated when the WLSMV estimator was used. Therefore, non-nested models with and without covariates could not be compared using model fit indices available and covariates were added to the overall model.

In subsequent models, any paths that were similar across time (e.g., cooperation with communication in Grades 1 and 2) were constrained to be equal and compared to the overall model. Any constraints that did not have a statistically significant change in fit were retained in the model and any constraints that resulted in a statistically significant change in chi-square were interpreted as degrading model fit and therefore were allowed to remain freely estimated to obtain the most parsimonious model. Indirect effects (statistically significant paths across three time points) were examined using the MODEL INDIRECT command in MPlus and 95% bootstrapped (5000) confidence intervals that did not include 0 interpreted as statistically significant.

Little's missing completely at random (MCAR) test was conducted to describe any pattern(s) of missing data. When the MCAR test was not statistically significant, MCAR was assumed, and when it was statistically significant, then the underlying t-tests comparing missingness among variables were examined to delineate any missing data patterns that may impact results and interpretation.

Covariates were compared using *t*-tests for continuous variables and chi-square tests for dichotomous variables based on those included or excluded from the analytic sample. Gender differences were explored using a multi-group model and were treated as a covariate upon convergence issues.

3 Results

3.1 Missing data

Most values of skewness and kurtosis were under the recommended ranges (i.e., under 3 for skewness and under 10 for kurtosis) except for child depression symptoms in Grade 1, which was slightly above 10.81 and deemed to be acceptable (47). Little's MCAR test was statistically significant [$\chi^2(101) = 128.104$, $p = 0.032$]; however, none of the underlying *t*-tests were statistically significant. The participating parents with data included in the analytic sample ($n = 943$) were compared to those who were not included ($n = 216$). Parents experiencing greater early socioeconomic risk were less likely to be included in the analytic sample [$t(203) = 3.258$, $p < 0.001$; 30.3% one or more risk factors in the analytic subsample vs. 40.3% in those not included]. There were no differences in parental internalizing symptoms scores [$t(1,058) = -0.255$, $p = 0.399$], hours in daycare [$t(156) = -1.55$, $p = 0.062$], or in the gender of the child [$\chi^2(1) = 0.015$, $p = 0.91$] between those included and those not included in the analytic sample. There was no evidence of problematic bias related to missing data patterns and thus we proceeded with our analytic plan.

3.2 Descriptive statistics

The means, standard deviations, and correlations for the study variables are provided in Table 1. Depression symptoms were associated with not having a best friend within each time point (age 4: $r = -0.12$, $p < 0.01$; Grade 1: $r = -0.08$, $p < 0.05$; Grade 2: $r = -0.11$, $p < 0.01$). Having a best friend was associated with better communication and cooperation skills within time (Grade 1: communication: $r = 0.13$, $p < 0.01$; cooperation: $r = 0.11$, $p < 0.01$; Grade 2: communication: $r = 0.07$, $p < 0.05$; cooperation: $r = 0.12$, $p < 0.01$) and better subsequent communication and cooperation skills (Grade 1 best friend to Grade 2 cooperation $r = 0.11$, $p < 0.01$, and Grade 1 best friend to Grade 2 cooperation $r = 0.13$, $p < 0.01$). Having a best friend at age 4 was also associated with better cooperation skills in Grade 2 ($r = 0.10$, $p < 0.01$). Depression symptoms showed associations across time (age 4 and Grade 1: $r = 0.19$, $p < 0.01$; and Grades 1 and 2: $r = 0.21$, $p < 0.01$; age 4 and Grade 2: $r = 0.19$, $p < 0.01$) and were consistently negatively associated with cooperation and communication skills in Grade 1 (communication: $rs = -0.28$ to -0.33, $p < 0.01$; cooperation: $rs = -0.23$ to -0.28, $p < 0.01$) and Grade 2 (communication: $rs = -0.25$ to -0.38, $p < 0.01$; cooperation: $rs = -0.18$ to -0.31, $p < 0.01$). Communication and cooperation skills were associated within (Grade 1: $r = 0.73$, $p < 0.01$; Grade 2: $r = 0.73$, $p < 0.01$) and across time (Grade 1 to Grade 2 communication: $r = 0.57$, $p < 0.01$; Grade 1 to Grade 2 cooperation: $r = 0.69$, $p < 0.01$; Grade 1 communication to Grade 2 cooperation: $r = 0.52$, $p < 0.01$; Grade 1 cooperation and Grade 2 communication: $r = 0.50$, $p < 0.01$).

3.3 Cross-lagged panel model

We began with a model (Model 1) that included within time associations (covariances), auto-regressive stability paths among constructs across time, and cross-lagged associations among depression symptoms (age 4, Grade 1, Grade 2), having a best friend (age 4, Grade 1, Grade 2), communication skills (Grade 1, Grade 2), and cooperation skills (Grade 1, Grade 2) along with paths from early socioeconomic risk, hours in daycare at age 4, parental internalizing symptoms, and child gender to all variables in the model. Fit indices for the models conducted can be found in Table 2. Model 1 fit the data well [$\chi^2(16) = 26.404$, $p = 0.049$; $CFI = 0.995$; $RMSEA = 0.026$, 95% CI 0.002–0.044].

Next, from Model 1, each set of paths that could be constrained to be equal across time were separately constrained to estimate the most parsimonious model similar to procedures in previous research (48). We found that constraining paths from depression symptoms to best friend [$\chi^2(1) = 0.014$, $p = 0.91$], best friend to depression symptoms [$\chi^2(1) = 0.069$, $p = 0.79$], best friend to communication [$\chi^2(1) = 0.013$, $p = 0.91$], best friend to cooperation [$\chi^2(1) = 0.169$, $p = 0.68$], and within time associations between depression symptoms and best friends [$\chi^2(2) = 2.313$, $p = 0.315$], communication and best friend [$\chi^2(1) = 2.07$, $p = 0.15$], and cooperation and best friend [$\chi^2(1) = 0.043$, $p = 0.84$] did not result in a statistically significant change in model fit so these constraints were retained in the final model. We found that constraining similar paths of depression symptoms to cooperation [age 4 to Grade 1, and Grade 1 to Grade 2: $\chi^2(1) = 13.357$, $p < 0.01$], depression symptoms to communication [age 4 to Grade 1, and Grade 1 to Grade 2: $\chi^2(1) = 14.978$, $p < 0.01$], stability of best friend [age 4 to Grade 1, and Grade 1 to Grade 2: $\chi^2(1) = 13.73$, $p < 0.01$], and within time associations between cooperation and communication [$\chi^2(1) = 21.084$, $p < 0.01$], depression symptoms and cooperation [$\chi^2(1) = 7.301$, $p < 0.01$], depression symptoms and communication [$\chi^2(1) = 9.531$, $p < 0.01$] degraded model fit and so were freely estimated in the final model. Constraining the auto-regressive paths for depression symptoms (age 4 to Grade 1, and Grade 1 to Grade 2) did not converge so these were freely estimated in the final model.

A final model (Model 2) was conducted including the associations in Model 1 and the constraints from depression to best friend, best friend to depression, best friend to communication, best friend to cooperation, depression symptoms and best friends, communication and best friend, and cooperation and best friend were retained. The remaining paths that were repeated over time and showed degradation in model fit with the

TABLE 1 Descriptive statistics.

	DEP age 4	DEP GR 1	DEP GR 2	COM GR 1	COM GR 2	COOP GR 1	COOP GR 2	Child gender	Early risk	PI age 4	Hours in daycare age 4	Mean	Standard deviation	Proportion (Yes)	*N*
Best friend age 4	**−0.120**	−0.030	−0.025	0.031	0.062	0.058	**0.101**		−0.030	−0.015	0.022			0.78	637
Best friend GR 1	−0.037	**−0.081**	−0.067	**0.130**	**0.108**	**0.109**	**0.129**		−0.037	−0.030	−0.043			0.56	871
Best friend GR 2	−0.044	−0.042	**−0.105**	0.053	**0.073**	0.053	**0.121**		**−0.089**	−0.040	0.008			0.60	897
DEP age 4		**0.205**	**0.192**	**−0.285**	**−0.249**	**−0.274**	**−0.184**	**−0.082**	**0.128**	**0.113**	−0.024	1.204	0.255		642
DEP GR 1			**0.577**	**−0.328**	**−0.276**	**−0.284**	**−0.245**	**−0.057**	**0.122**	**0.125**	0.017	1.127	0.218		873
DEP GR 2				**−0.284**	**−0.380**	**−0.233**	**−0.313**	**−0.115**	**0.202**	**0.131**	−0.070	1.128	0.215		898
COM GR 1					**0.574**	**0.726**	**0.518**	**0.229**	**−0.144**	**−0.098**	−0.069	22.919	3.236		863
COM GR 2						**0.503**	**0.727**	**0.252**	**−0.178**	**−0.094**	0.029	23.185	3.338		885
COOP GR 1							**0.690**	**0.288**	**−0.181**	**−0.08**	−0.026	19.671	3.231		868
COOP GR 2								**0.307**	**−0.219**	**−0.119**	0.015	19.591	3.379		886
Child gender									−0.022	0.024	0.015				942
Early risk										**0.266**	−0.014	0.419	0.737		916
PI age 4											0.080	1.285	0.355		932
Hours in daycare age 4												34.652	6.198		909

GR, Grade; DEP, depression symptoms; COM, communication; COOP, cooperation; PI, parental internalizing symptoms.
Best friend is a dichotomous variable and proportions are included for these variables. Bold represents correlations $p < 0.05$.

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constraints were allowed to be freely estimated. This model also fit the data well [$\chi^2(24) = 32.043$, $p = 0.56$; $CFI = 0.996$; $RMSEA = 0.019$, 95% CI 0.000–0.034], did not statistically significantly differ from Model 1 [$\chi^2(8) = 6.044$, $p = 0.642$], and is depicted in Figure 1.

All unstandardized and standardized coefficients for Model 2 are provided in Supplementary Table S3. In this model, we found that having a best friend showed stability (i.e., age 4 predicted Grade 1: $\beta = 0.20$, $p < 0.01$; Grade 1 predicted Grade 2: $\beta = 0.55$, $p < 0.01$), depression symptoms showed stability (i.e., age 4 predicted Grade 1: $\beta = 0.19$, $p < 0.01$; Grade 1 predicted Grade 2: $\beta = 0.53$, $p < 0.01$), and communication skills ($\beta = 0.44$, $p < 0.01$) and cooperation skills ($\beta = 0.64$, $p < 0.01$) showed stability from Grade 1 to Grade 2. At age 4 ($r = -0.09$, $p < 0.01$), Grade 1 ($r = -0.10$, $p < 0.01$), and in Grade 2 ($r = -0.13$, $p < 0.01$), not having a best friend was concurrently associated with depression symptoms. Having a best friend predicted later cooperation skills (i.e., age 4 to Grade 1: $\beta = 0.07$, $p = 0.033$; Grade 1 to Grade 2: $\beta = 0.07$, $p = 0.033$). In Grade 1, having a best friend was positively associated with communication skills ($r = 0.09$, $p < 0.01$) and in Grade 2 ($r = 0.11$, $p < 0.01$). Depression symptoms were negatively associated with communication (Grade 1: $r = -0.27$, $p < 0.01$; Grade 2: $r = -0.24$, $p < 0.01$) and cooperation skills (Grade 1: $r = -0.23$, $p < 0.01$; Grade 2: $r = -0.19$, $p < 0.01$) within time at both Grade 1 and Grade 2. Communication and cooperation skills were also positively associated at both time points (Grade 1: $r = 0.69$, $p < 0.01$; Grade 2: $r = 0.64$, $p < 0.01$). Depression symptoms at age 4 were negatively associated with communication ($\beta = -0.28$, $p < 0.01$) and cooperation ($\beta = -0.22$, $p < 0.01$) skills in Grade 1. Depression symptoms in Grade 1 were also significantly negatively associated with communication skills in Grade 2 ($\beta = -0.08$, $p < 0.01$), but not with Grade 2 cooperation skills ($\beta = -0.04$, $p = 0.14$). Communication skills in Grade 1 were negatively related to depression symptoms in Grade 2 ($\beta = -0.11$, $p < 0.01$), and cooperation skills in Grade 1 positively predicted communication skills in Grade 2 ($\beta = 0.11$, $p < 0.01$).

TABLE 2 Fit indices for cross-lagged panel model of depression symptoms, cooperation, communication skills, and best friend.

Model	*CFI*	*RMSEA* (90% CI)	χ^2	df	*p*	Comparison	χ^2	df	*p*-value
1. Overall model including auto-regressive, covariance, and cross-lagged paths among depression, cooperation, communication and best friend with covariates of early risk, gender of child, parental mental health, and hours in daycare	0.995	.0026 (0.002–0.044)	26.404	16	0.049				
2. Final model with gender of child, early risk, and parental internalizing symptoms; constraints incorporated	0.996	0.019 (0.000–0.034)	32.043	24	0.126	2 vs. 1	6.044	8	0.642

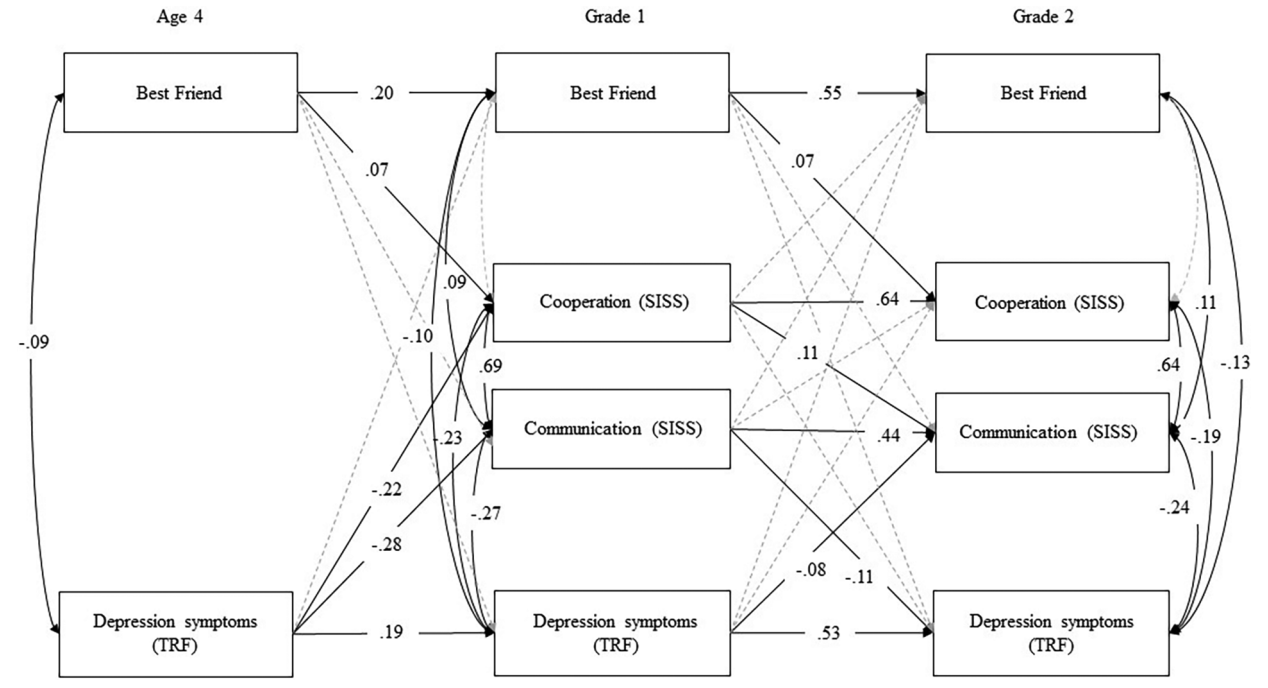

FIGURE 1
Cross-lagged panel model of depression symptoms, cooperation, communication, and best friend with covariates of gender of child, early risk, and parental internalizing symptoms paths (model 2: final model with constraints incorporated). Note: Standardized estimates. See Table 2 for fit indices and Supplementary Table S3 for all unstandardized and standardized path estimates. Gray paths were estimated but were not statistically significant.

3.3.1 Indirect effects

Two indirect effects were tested: (1) age 4 depression symptoms to Grade 1 communication skills to Grade 2 depression symptoms [$b = 0.026$, $\beta = 0.031$, 95% CI (0.009, 0.043)], (2) age 4 depression symptoms to Grade 1 cooperation skills to Grade 2 communication skills [$b = -0.312$, $\beta = -0.024$, 95% CI (−0.549, −0.076)] and both were statistically significant as depicted in Figure 2.

3.3.2 Covariates

The covariates also had multiple statistically significant associations within the model. The path estimates (unstandardized and standardized) related to the covariates can be observed in Table 3. Specifically, early socioeconomic risk was positively related to depression symptoms at every time point with the exceptions of having a best friend at age 4 and in Grade 1, negatively related to communication and cooperation skills at both time points, and related to not having a best friend in Grade 2. Parental internalizing symptoms when the child was 4 years old predicted depression symptoms at age 4 and Grade 1 but not at Grade 2, and negatively predicted Grade 2 cooperation skills. Parental internalizing symptoms and early socioeconomic risk were also significantly associated. Being a boy was associated with more depression symptoms at age 4 and in Grade 2. Being a girl was associated with better communication and cooperation skills at both time points and having a best friend in Grade 1.

4 Discussion

Our aim was to assess the longitudinal associations between depression symptoms in early childhood, having a best friend, and early school-age social skills of cooperation and communication. We found that young children experiencing depression symptoms were less likely to have a best friend (age 4, Grade 1, and Grade 2) and their communication and cooperation skills were concurrently impaired. Impairment in communication and cooperation skills also persisted over time.

The results suggested an indirect effect where depression symptoms at age 4 negatively predicted communication skills in Grade 1, which in turn negatively predicted depression symptoms in Grade 2. Those with higher depression symptoms at age 4 had poorer communication skills in Grade 1, which was associated with higher depression symptoms in Grade 2. This may not be a surprising finding since depressed children are shown to interact less with others (3) and are thus likely to have fewer opportunities to practice their communication skills with their peers. That is, a higher frequency of negative peer interactions and fewer opportunities to interact likely interferes with the reinforcement needed to effectively establish good communication skills. Since communication skills are important for developing friendships (30), impairment in this area may have an impact on peer relations. Given the protective role of

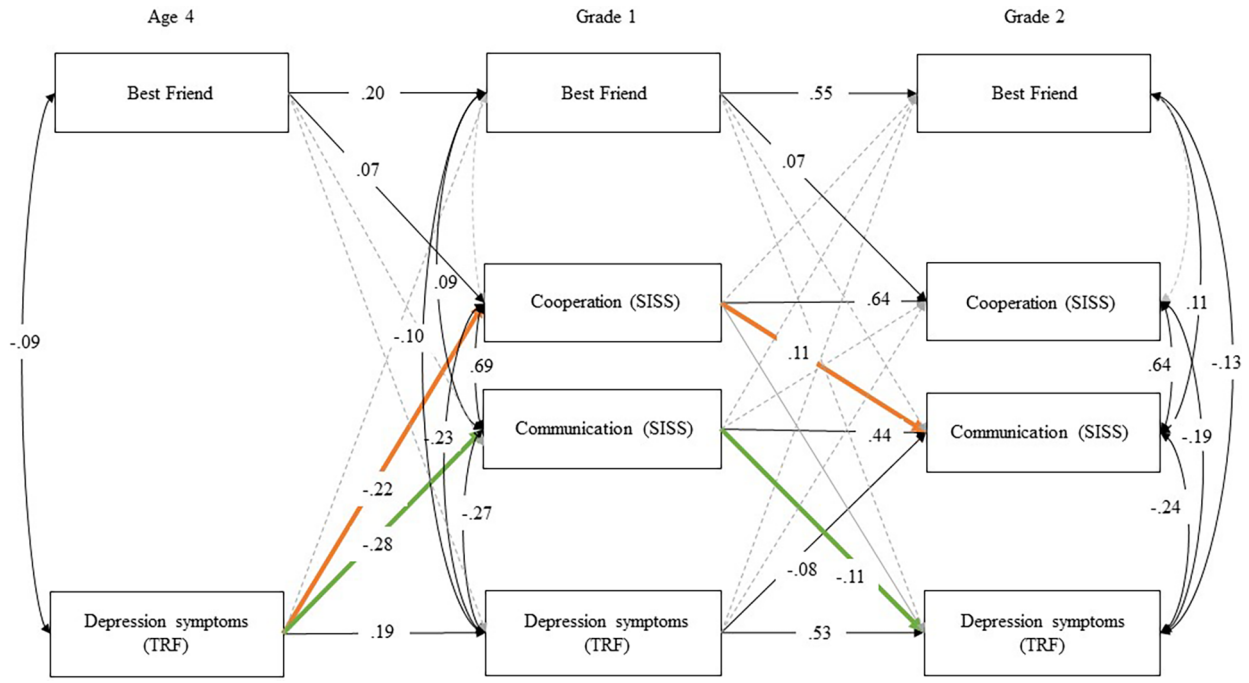

FIGURE 2
Indirect effects of cross-lagged panel model of depression symptoms, cooperation, communication, and best friend with covariates of gender of child, early risk, and parental internalizing symptoms paths (model 2: final model with constraints incorporated.). Note: Standardized estimates. See Table 2 for fit indices and Supplementary Table S3 for all unstandardized and standardized path estimates. Gray paths were estimated but were not statistically significant. Indirect effects: Age 4 depression symptoms (TRF) → Grade 1 communication (SSIS) → Grade 2 depression symptoms (TRF) $b = 0.026$, $\beta = 0.031$, 95% CI (0.009, 0.043); Age 4 depression symptoms (TRF) → Grade 1 cooperation (SSIS) → Grade 2 communication (SSIS) $b = -0.312$, $\beta = -0.024$, 95% CI (−0.549, −0.076).

friendship for young children with genetic predispositions for depression symptoms (10), support in developing communication skills may help children build friendships. Still, to maintain such friendships, cooperation skills may also be necessary (30).

Depression symptoms at age 4 negatively predicted cooperation in Grade 1, but was not consistent over time (i.e., the path from depressive symptoms in Grade 1 to cooperation skills in Grade 2 was not statistically significant). Cooperation skills in Grade 1 positively predicted communication skills in Grade 2. The indirect effect from age 4 depression symptoms to Grade 1 cooperation to Grade 2 communication skills was significant, meaning that higher depression symptoms at age 4 were related to lower cooperation skills in Grade 1, which in turn were related to lower communication skills in Grade 2. Early depression symptoms may be leading to deficits in cooperation and communication skills over time, which are important for building and maintaining friendships (30). Since depression symptoms are reported both within the preschool/daycare context by daycare teachers and the formal school setting by teachers, the presence of these indirect effects from preschool into Grade 2 are noteworthy and require replication.

Higher depression symptoms at age 4 were associated with not having a best friend at each time point.

The positive associations between having a best friend and later cooperation skills were present from age 4 to Grade 1 and Grade 1 to Grade 2. This supports the literature suggesting cooperation skills are important in the maintenance of friendships in early childhood and our model suggests that having a best friend predicts later cooperation skills and not the reverse (30). Early relationships are likely important for the development of cooperation skills in young children. Conversely, when these relationships are not present in the lives of young children, more support in developing cooperation skills should be considered for future friendship maintenance.

Being a girl was associated with better communication and cooperation skills in Grades 1 and 2. Better cooperation skills have been found for girls in previous research (32). Girls tend to acquire language skills more quickly than boys and developmental disorders involving communication are more prevalent in boys (49). This may relate to the earlier onset of language within girls, which impacts communication and cooperation skills (50). There is established research literature supporting that communication and language abilities advance more quickly for girls and this finding is robust (51).

Early socioeconomic risk was associated with not having a best friend in Grade 2, higher depression symptoms at each time point, and lower cooperation and communication skills across time. Socially disadvantaged children have been found to experience language delays, including general communication skills, also in relatively affluent societies such as the Norwegian (52, 53). Parental self-reported internalizing symptoms were associated with teacher-rated depression symptoms at age 4 and in Grade 1 and were correlated with early socioeconomic risk. Being a boy was associated with depression symptoms at age 4 and in Grade 2. The gender difference in depression symptoms favoring girls occurs after puberty; before puberty, the rates of depression are low in both girls and boys (54). Due to the low frequency of depression symptoms in early childhood in the general population and the tendency for studies in early childhood to have smaller sample sizes, the inconsistency in gender differences in early childhood may relate to lack of power to detect the effects. More research is needed with larger samples examining gender differences in depression symptoms to better understand the development for boys and girls.

The early socioeconomic risk measured at 6 and 12 months was associated with most study variables. There is a long history of socioeconomic status conferring risk for poor mental health among children, particularly for indicators related to low income and parental education (55–57). Either parent having internalizing symptoms was a risk factor for concurrent and later depression symptoms in children, consistent with the well-established literature linking parental psychopathology and child maladjustment (58, 59). A previous study shows that children in Grade 2 make significant gains in social skill development of communication and cooperation, and this corresponded with a decrease in internalizing symptoms (20). However, in another study there was no statistically significant change in internalizing symptoms in Grade 1 and the effect sizes of gains in social skills were half of those found in the (20) study (60). It may be that a certain amount of skill development needs to occur before this has an influence on internalizing symptoms. The impact of interventions for cooperation and communication skills and depression symptoms in young children, particularly those experiencing early socioeconomic risk, needs to be evaluated in future research.

Our study had significant strengths, including a relatively large sample for early childhood studies that was longitudinal with little attrition (33) and good measurement of constructs. However, as is the case with all studies, there are limitations. First, a composite of consistent items of child depression symptoms could not be created from age 4 to Grade 1 and Grade 2. The older children had consistent items from Grade 1 to Grade 2 and therefore did not have this issue. Future research should use consistent items over all time points to replicate our findings. Second, we did not have corresponding measures of cooperation and communication skills at age 4, thus it is possible that deficits in these skills may have started earlier than Grade 1. Third, we measured best friends at school and children could have had a best friend in a different context (e.g., neighborhood, family, extracurricular activities). Fourth, there are likely other covariates that could have an impact on our results. For example, depression symptoms have been linked to academic performance (61). Finally, we examined child gender as a covariate instead of in a multi-group model due to problems with convergence. Studies with larger samples should examine how gender moderates the associations between depression symptoms, communication, and cooperation skills, and having a best friend in young children over time.

4.1 Implications

Our results suggest that early intervention for depression symptoms should be considered in relation to social skill development in the early school-age years. Programs aimed at the prevention of internalizing symptoms in the preschool period

do exist and have some evidence of efficacy in the short term (62) and into middle childhood for girls (63). Further, some children, particularly those with elevated depression symptoms, may also benefit from more support in developing cooperation and communication skills. Our indirect effect of depression symptoms predicting communication deficits, which in turn predicts depression symptoms, suggests that poor communication skill development may be a maintenance factor for depression symptoms in young children. Importantly, communication skills are modifiable and one of the social skills that is more consistently influenced by intervention efforts (20). More research is needed to determine whether, or at what point during or after treatment of depression symptoms, communication skills training influences the development of children's friendships. There is some support for social-emotional learning influencing emotional distress for school-aged children (kindergarten to Grade 12) (64). Participating in social skills training programs has also shown to somewhat decrease internalizing symptoms, with the largest effect sizes for the skills of cooperation and communication (20). A meta-analysis showed that class-wide social skills interventions in preschool, elementary, and secondary school were minimally effective; however, younger children participating in the program (i.e., preschool and kindergarten) seemed to have benefited the most from the program (65). A targeted approach for those who are more at risk of social skill deficits may also play an important role in supporting the equitable development of social skills. In line with this, those who experience heightened early socioeconomic risk, increased parental internalizing symptoms (of either parent), and being boys may be groups that warrant intervention and prevention efforts for depression symptoms, communication skills, and cooperation skills. The cost of implementing these programs is small in comparison to the cost of treatment once diagnostic criteria are met; therefore, the public health benefit in the long term may be significant with investment in early childhood mental health programs (63).

In sum, we showed prospective associations between symptoms of depression and poorer social skills (cooperation, communication, and friendships) in early childhood and the first few years of school. The temporal pattern of findings suggests that deficits in communication skills may be a maintenance factor for depression symptoms and that deficits in cooperation skills further degrade communication skills. Early socioeconomic risk, parental internalizing symptoms, and child gender, were associated with depression symptoms and cooperation and communication skills. Given that depression symptoms negatively impact the development of communication skills, cooperation skills, and friendships, it is important to intervene early with young children who have depression symptoms.

Data availability statement

The data analyzed in this study are subject to the following licenses/restrictions: The data are part of an ongoing longitudinal study and contain potentially sensitive information. The consent of the participants of the Behavior Outlook Norwegian Developmental Study (BONDS), as approved by the Regional Committee for Medical and Health Research Ethics in South-East Norway does not include sharing a de-identified data set on an open server. In compliance with the approval and consent for the study, researchers who meet the criteria for access to confidential data may be given access to de-identified data via a secure server, under a data processing agreement. Requests for data access should be directed to the Norwegian Center for Child Behavioral Development (NUBU), Oslo, Norway (mail: post@nubu.no) or to the corresponding author (ane.narde@nubu.no).

Ethics statement

The studies involving humans were approved by Regional Committee for Medical and Health Research Ethics and the Norwegian Social Sciences Data Services (approval numbers S-06067; 2009/224a). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

AK: Conceptualization, Formal Analysis, Writing – original draft, Writing – review & editing. TV: Conceptualization, Funding acquisition, Supervision, Writing – review & editing. HJ: Conceptualization, Funding acquisition, Methodology, Project administration, Writing – review & editing. TI: Conceptualization, Funding acquisition, Methodology, Project administration, Writing – review & editing. AN: Conceptualization, Funding acquisition, Methodology, Project administration, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frcha.2024.1328527/full#supplementary-material

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Maternal and psychosocial antecedents of anxiety and depression in extremely low gestational age newborns at age 15 years

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Objectives: The prevalence of many psychiatric symptoms, including anxiety and depression, is higher in individuals born extremely preterm (EP) than in term-born individuals during childhood and adolescence. In this prospective study of adolescents born EP, we examined associations between early-life risk factors (prenatal maternal health conditions, socioeconomic and social factors) and anxiety and depression at 15 years of age.

Methods: We included 682 participants (53.2% White, 57.8% male) who were born <28 weeks gestation. Data on demographic factors, maternal health conditions and socioeconomic status (SES) were collected in the first postnatal month, and data on the outcomes (anxiety and depression) were collected at 15 years by a structured clinical diagnostic interview. At the 15-year visit, the mother reported on her own experiences of childhood trauma. Logistic regression models were used to evaluate associations between maternal health indicators, SES factors and mothers' childhood trauma and adolescent outcome variables of anxiety, depression and both anxiety and/or depression, adjusting for potential confounding factors and expressed as adjusted odds ratios (aOR) and 95% confidence intervals (CI).

Results: Maternal pre-pregnancy obesity was associated with anxiety (aOR: 1.84, 95% CI: 1.15, 2.95) and depression (aOR: 1.95, 95% CI: 1.17, 3.23) in adolescents at age 15. Maternal exposure to active or second-hand smoke was associated with depression (aOR: 1.8, 95% CI: 1.08, 3.00) and with anxiety and depression (aOR: 2.83, 95% CI: 1.51, 5.31) at age 15. Other maternal pre-pregnancy health indicators of interest including asthma, hypertension and diabetes mellitus did not demonstrate significant associations with symptoms of anxiety or depression in adolescents at age 15 in univariable and multivariate analyses.

Maternal childhood experience of parental upheaval was associated with anxiety and depression (OR: 1.91, 95% CI: 1.01, 3.55) in adolescents, and maternal childhood experience of victim violence was linked with anxiety (OR: 2.4, 95% CI: 1.22, 4.62) and anxiety and depression (OR: 2.49, 95% CI: 1.05, 5.42).
Conclusion: These findings suggest that prenatal maternal health and socioeconomic factors contribute to psychiatric disorders among adolescents born EP. These factors could serve as targets for interventions to improve mental health of individuals born EP.

KEYWORDS

adolescents, preterm, anxiety, depression, socioeconomic status, maternal health

1 Introduction

Nearly 15 million infants worldwide are born preterm [<37 weeks' gestational age (GA)] every year (1). The subgroup of extremely preterm (EP) births (<28 weeks gestation) comprises approximately 6% of all preterm births and less than 1% of all births. Despite advances in technology and care of these infants leading to increased survival, EP and extremely low birth weight (ELBW; <1,000 grams) infants still remain at high risk for death and disability. There remains a 30%–50% mortality and, in survivors, a 20%–50% risk of morbidity (2, 3). The prevalence of psychiatric symptoms during childhood and adolescence is significantly higher in individuals born EP and/or ELBW than in term-born individuals (2–4 times increased odds) (4–8). We have previously reported that at 15 years of age, 11% of girls and 5% of boys born EP have generalized anxiety and 6% of girls and 2% of boys have depression, and these diagnoses are more prevalent when compared to general population epidemiologic adolescent studies in the U.S. (4).

EP infants may undergo altered development of their stress-regulatory systems since the third trimester of pregnancy represents a sensitive phase of infant brain plasticity (9, 10). Due to their immature neurobiological system and subsequent exposure to intensive medical treatments and extended stay in the Neonatal Intensive Care Unit (NICU), the infant's natural regulatory capacity may be exceeded leading to permanent alterations in their neuroendocrine, autonomic, cardiovascular and neuronal responses (11–13). These early exposures to physical and environmental stressors may increase the brain's vulnerability to stress later in life and subsequent development of psychopathology, especially during adolescence (14). EP infants in the NICU may also experience atypical maternal care due to obstruction of physical and emotional closeness, a critical factor in the early regulation of the infant's stress responses, leading to an increased risk of disruption of the maternal-infant attachment (9, 15). Longer NICU hospitalizations have also been associated with worse neurodevelopmental outcomes at 2–3 years of age (16, 17). Despite the higher prevalence of mental health conditions in individuals born EP, few studies have evaluated their mental health outcomes during adolescence.

Anxiety and depressive disorders are among the most important health challenges faced by adolescents in the general population (18). These disorders are common with an estimated lifetime prevalence of 7.3%–28.8% and are associated with substantial functional impairment, with an estimated cost between $42 and $47 billion to the US economy each year (19, 20). Like many other psychiatric conditions, anxiety and depressive disorders have their onset in childhood. Data from the National Comorbidity Survey Replication (NCS-R), a nationally representative epidemiologic study, reported that exposure to early-life stress and trauma has been associated with the development of depression, panic disorder, and an abnormal stress response (21). Results from nationwide birth cohort studies (22, 23), indicated multifactorial etiologies including psychological, social, familial, and biological factors (eg: puberty, hormones and immune system regulation factors) in increasing vulnerability to internalizing disorders like anxiety in adolescent females. The presence of anxiety and depressive symptoms can have significant long-term impacts including poor academic performance, behavioral problems, poor self-worth, and substance use, which may persist into adulthood (24–27). Despite these detrimental outcomes, anxiety disorders in adolescents are undertreated, with only 18% engaged in treatment (28). Given that children born EP are at an increased risk for anxiety and depression during adolescence and young adulthood (4, 26, 29), it is imperative to investigate and identify factors that may contribute to or mitigate the expression of these disorders.

In individuals exposed to significant early-life stress, such as the Extremely Low Gestational Age Newborn (ELGAN) cohort, social environment has an enormous impact on the individual due to its impact on brain development (30). A maternal childhood history of trauma and maltreatment is associated with increased mental health challenges, social isolation, and altered developmental expectations (31). Children of mothers who have had exposure to adverse childhood experiences have an increased risk for anxiety (30), depressive symptoms, aggression, and hyperactivity (32–34), largely due to resultant lack of access to social support and resources that can potentially address these negative exposures (35, 36). Exposure to trauma in childhood can lead to aggressive response biases in adulthood and can thus influence the immediate family environment and caregiving quality in this already vulnerable population (35–37). Thus, in addition to major life events, abuse, and neglect, the day-to-day experiences in family, neighborhood, school, and work environments may affect neurobiological and behavioral functions. Socioeconomic status (SES), which includes both income and education, is also a strong predictor of brain and body health, including anxiety and depressive symptoms (26, 30).

Our objective was to identify early life risk factors that might be associated with EP birth and anxiety and depression later in life in

adolescents born EP. This work can provide targets for intervention to ameliorate or prevent anxiety and depression in this population.

2 Methods

2.1 Study participants

The ELGAN study is a longitudinal, observational study of individuals born EP between 2002 and 2004 in 11 cities in 5 states (38, 39). For the current study, data on the exposure (maternal health conditions and SES) were collected within a few days of the delivery of the ELGAN participant, maternal childhood trauma history and offspring psychiatric outcomes (anxiety and depression) were collected at the age 15-year visit (40). Data about neonatal characteristics were collected from a review of the neonatal medical record at birth. Biological sex was recorded by the neonatologist or pediatrician as biological male, biological female or ambiguous (henceforth referred to as male/female in the manuscript).

During the years 2002–2004, women delivering before 28 weeks' gestation in 11 cities in 5 states were asked to enroll in the first phase of the study. All procedures for this study were approved by the institutional review boards of all participating institutions.

2.2 Perinatal data

Data on maternal demographic factors, pre-pregnancy health, pregnancy complications, and medical treatments were collected by maternal interview within a few days of delivery, and by a review of maternal medical records by research assistants, with oversight from neonatologists at each recruitment site. Data included race, ethnicity, marital status, maternal age, health insurance, pre-pregnancy weight and height, active and passive smoke exposure, maternal medical disorders, and maternal medications. Smoke exposure was measured as described in Venkatesh et al., 2021 (41).

Maternal health characteristics included pre-pregnancy body mass index (BMI) categories (underweight: <18.5, healthy weight: 18.5–25, overweight: >25–30, and obese: >30), pre-pregnancy diagnosis of asthma and diabetes, and pre-pregnancy/pregnancy/delivery hypertension symptoms. Potentially life-threatening maternal pregnancy complications and indications for premature delivery, as well as Hemolysis, Elevated Liver enzymes and Low Platelets (HELLP) syndrome and preeclampsia, were included. A composite variable was defined as having displayed any of the aforementioned hypertensive disorders, HELLP, or preeclampsia. Whether mother smoked or was exposed to second-hand smoke during pregnancy was ascertained by maternal interview; and a composite exposure was defined for mothers' who either smoked or were exposed to second-hand smoke during pregnancy.

The following socioeconomic variables were included: education (less than high school), marital status (not married or not living together), insurance (public insurance or no insurance), and Supplemental Nutrition Assistance Program (SNAP) eligibility.

Newborn characteristics included sex, birth weight, gestational age, and medical conditions known to commonly occur in EP infants such as, intraventricular hemorrhage, white matter damage, chronic lung disease, sepsis, severe retinopathy of prematurity, and necrotizing enterocolitis. Since the focus of the current manuscript was on maternal health and psychosocial antecedents of anxiety and depression, these variables were not included and reported in the present analysis.

The Childhood Trauma Questionnaire [CTQ; (42); ECHO-wide Cohort version 01.20] was completed by 438 mothers during the age 15 visit. It provided a description of maternal exposure to death of a family member/very close friend, parent upheaval such as divorce, separation, etc., sexual trauma, victim violence (other than sexual violence), being extremely ill/injured, or any other upheaval. It also obtained data on a 7-point Likert scale on how traumatic the experience was for the mother. Internal consistency in a community sample was acceptable for the entire measure (Cronbach's alpha = 0.91) and four of the five subscales (ranging from 0.58 for Physical Neglect to 0.94 for Sexual Abuse (43). In clinical samples, the CTQ has demonstrated test-retest reliability coefficients from 0.79 to 0.86, internal consistency reliability coefficients ranging from 0.66 to 0.92, convergent validity with clinician ratings of abuse, and a consistent five-factor structure (42).

2.3 Neuropsychiatric assessments

The Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID 7.0.2) (44) is a structured clinical diagnostic interview tool designed to assess the presence of current DSM-5 and ICD-10 psychiatric disorders in children and adolescents aged 6–17 years. It is used for psychiatric evaluation and outcome monitoring in clinical psychopharmacology trials and epidemiological studies in more than 100 countries. The interview is administered to the child/adolescent together with the parent(s), although it can be administered to adolescents without a parent present. The MINI-KID follows the structure and format of the adult version of the interview (MINI), which has been validated against the Structured Clinical Interview for DSM-III-R and against the World Health Organization–designed Composite International Diagnostic Interview. Like its adult counterpart, the MINI-KID is organized in diagnostic sections or modules, and is administered using branching tree logic (e.g., 2–4 screening questions for each disorder, with additional questions being asked only if the screen questions are positively endorsed). The instrument screens for 24 DSM-5 and ICD-10 psychiatric disorders and suicidality and takes approximately 30 min to complete. The MINI-KID has substantial to excellent concordance with the gold standard K-SADS-PL (area under the curve = 0.81–0.96, ≥0.56–0.87). Sensitivity was 0.61–1.00 for 15/20 individual disorders, and specificity was 0.81–1.00 for 18 disorders and >0.73 for the remaining two. Interrater and test-retest kappas were 0.64–1.00 for all individual disorders except dysthymia. It has recently been updated to map onto DSM-5 (MINI 7.0.2) diagnostic criteria.

The primary outcomes for our analyses were presence of any form of anxiety (i.e., generalized anxiety disorder, separation anxiety disorder, social anxiety disorder, panic disorder lifetime/current, specific phobia, and agoraphobia), depression (major

depressive disorder current/recurrent/past), as assessed by the MINI-KID, anxiety-or-depression, in which participants met the cut-offs for either disorder, and anxiety-and-depression, indicating that they met cut-offs for the comorbidity of both disorders, thereby indicating greater illness severity.

2.4 Statistical analysis

We evaluated the association between the following sets of exposures: maternal health conditions, SES indicators during pregnancy, history of maternal childhood trauma with four outcomes: anxiety, depression, and anxiety-or-depression, and anxiety-and-depression at 15 years of age. Based on sex differences in the prevalence of psychiatric disorders, we also evaluated sex as a modifier of associations between perinatal factors and adolescent psychiatric disorder (45, 46). Regression models were used to evaluate associations between psychiatric outcomes of anxiety, depression, anxiety-or-depression, and anxiety-and-depression, and antecedents, including prenatal maternal health factors as well as SES factors. For maternal education and marital status variables, both of which consisted of five categories, a secondary set of binary variables- college education and married- were also defined to explore these factors' associations without the small sample size effects of some categories. In the same regard, the very small number of mothers whose marital status were "widowed" were analyzed along with mothers "separated or divorced", under the "separated or divorced or widowed" category (Table 2). Statistical significance was defined as $p < 0.05$. After conducting univariate analyses, multivariate regression analyses were conducted. The variables for adjustment were determined using directed acyclic graphs, DAGs, to determine a minimally sufficient set of adjustment variables for inclusion in the models (see Supplementary Figures). Adjustment variables are listed in Supplementary Table 1. Based on the finding that pre-pregnancy exposure to adverse experiences has been associated with increased risk of maternal health conditions like hypertension, preterm birth and detrimental maternal mental health outcomes (31), severity of trauma as measured by the CTQ was included as a confounding variable.

3 Results

A total of 1,506 infants, born to 1,249 mothers, were enrolled in the ELGAN study. Of the 1,198 children assessed in this longitudinal study at age ten, 516 participants were lost to follow-up or not recruited in this age 15 analysis. Four participants did not have any measures of depression or anxiety completed and were excluded from this current report. Youth with anxiety symptoms ($N = 155$) included those with anxiety alone ($N = 85$) and those with anxiety and depression comorbid ($N = 70$). Youth under the depression category ($N = 117$) included those with depression only ($N = 47$) and those with both, depression and anxiety symptoms ($N = 70$; see Figure 1). No

TABLE 1 Characteristics of ELGAN study participants.

Characteristic	Died by age 10	Alive not in sample	Alive in sample
	N = 308	*N* = 516	*N* = 682
Maternal characteristics			
Maternal age			
Under-21	48 (15.7%)	89 (17.2%)	81 (11.9%)
21–35	215 (70.3%)	350 (67.8%)	452 (66.3%)
Over-35	43 (14.1%)	77 (14.9%)	149 (21.8%)
(missing)	2	0	0
Race			
White	160 (53.2%)	257 (50.8%)	449 (66.7%)
Black	105 (34.9%)	165 (32.6%)	157 (23.3%)
Asian	6 (2.0%)	15 (3.0%)	13 (1.9%)
Native American	2 (0.7%)	10 (2.0%)	2 (0.3%)
Mixed Race	14 (4.7%)	16 (3.2%)	19 (2.8%)
Other	14 (4.7%)	43 (8.5%)	33 (4.9%)
(missing)	7	10	9
Hispanic Ethnicity	32 (10.7%)	84 (16.4%)	63 (9.3%)
(missing)	8	3	3
Marital status			
Married	163 (53.6%)	242 (46.9%)	443 (65.1%)
Separated or divorced	9 (3.0%)	15 (2.9%)	26 (3.8%)
Not ever married but living together	61 (20.1%)	133 (25.8%)	112 (16.4%)
Not ever married and not living together	70 (23.0%)	126 (24.4%)	99 (14.5%)
Widowed	1 (0.3%)	0 (0.0%)	1 (0.1%)
(missing)	4	0	1
Education			
Less than high school	50 (20.1%)	107 (21.9%)	85 (12.8%)
High school graduate	77 (30.9%)	155 (31.7%)	159 (24.0%)
Some College	70 (28.1%)	117 (23.9%)	153 (23.1%)
College Graduate	35 (14.1%)	66 (13.5%)	147 (22.2%)
More than College	17 (6.8%)	44 (9.0%)	119 (17.9%)
(missing)	59	27	19
Eligible forMedicaid	130 (49.6%)	243 (48.4%)	221 (32.9%)
(missing)	46	14	11
Eligible for Food Stamps	49 (18.9%)	92 (18.4%)	74 (11.0%)
(missing)	49	16	11
Maternal health characteristics			
Body mass index	27 (7.9)	25 (6.3)	26 (6.9)
(missing)	57	26	25
Prepregnancy body mass index			
Healthy Weight	96 (38.2%)	254 (51.8%)	329 (50.1%)
Under Weight	18 (7.2%)	42 (8.6%)	48 (7.3%)
Over Weight	62 (24.7%)	99 (20.2%)	127 (19.3%)
Obese	75 (29.9%)	95 (19.4%)	153 (23.3%)
(missing)	57	26	25
Prepregnacyasthma	44 (17.1%)	68 (13.7%)	88 (13.2%)
(missing)	50	18	16
Prepregnacy diabetes	9 (3.5%)	13 (2.6%)	21 (3.2%)
(missing)	50	18	16
Prepregnancy high blood pressure	24 (9.3%)	41 (8.2%)	41 (6.2%)
(missing)	50	18	16
hypertension during pregnancy	50 (19.5%)	77 (15.5%)	100 (15.0%)
(missing)	51	19	17
Preeclampsia	25 (9.7%)	46 (9.3%)	68 (10.2%)
(missing)	51	19	17

(*Continued*)

TABLE 1 Continued

Characteristic	Died by age 10	Alive not in sample	Alive in sample
	N = 308	*N* = 516	*N* = 682
Preeclampsia or pmom dschg dx pih/tox/eclamp ob1	39 (12.7%)	72 (14.0%)	96 (14.1%)
Mom dschg dx hellp ob1	14 (4.5%)	14 (2.7%)	30 (4.4%)
Hypertension prepregnany or during pregnancy	69 (22.4%)	103 (20.0%)	140 (20.5%)
Smoked while pregnant	50 (19.5%)	69 (13.8%)	93 (13.9%)
(missing)	51	17	14
Passive smoke exposure	75 (29.8%)	142 (28.7%)	151 (22.7%)
(missing)	56	21	16
Smoked while pregnant or prenatal active passive Smoke Exposure	94 (36.6%)	162 (32.5%)	176 (26.3%)
(missing)	51	17	14
Newborns characteristics			
Sex-Male	178 (57.8%)	270 (52.3%)	351 (51.5%)
Birth Weight *Z*-Score			
<−2	48 (15.6%)	20 (3.9%)	42 (6.2%)
<−1	58 (18.8%)	67 (13.0%)	86 (12.6%)
−1 to 1	189 (61.4%)	371 (71.9%)	469 (68.8%)
>1	12 (3.9%)	50 (9.7%)	71 (10.4%)
>2	1 (0.3%)	8 (1.6%)	14 (2.1%)
Gestational Age			
23–24	164 (53.2%)	100 (19.4%)	145 (21.3%)
25–26	108 (35.1%)	241 (46.7%)	312 (45.7%)
27	36 (11.7%)	175 (33.9%)	225 (33.0%)
Intraventricular hemorrhage	107 (41.3%)	88 (17.1%)	156 (22.9%)
(missing)	49	2	0
White matter damage	105 (40.5%)	103 (20.0%)	139 (20.4%)
(missing)	49	2	0
Chronic lung disease	46 (86.8%)	237 (46.5%)	361 (53.2%)
(missing)	255	6	4
Sepsis			
None	105 (43.4%)	189 (36.7%)	256 (37.5%)
Presumed	59 (24.4%)	177 (34.4%)	233 (34.2%)
Sepsis	78 (32.2%)	149 (28.9%)	193 (28.3%)
(missing)	66	1	0
Severe retinopathy of prematurity	17 (23.9%)	61 (12.1%)	95 (14.1%)
(missing)	237	11	10
Necrotizing enterocolitis			
None or mild	244 (80.3%)	479 (92.8%)	631 (92.5%)
Medical necrotizing enterocolitis	5 (1.6%)	6 (1.2%)	5 (0.7%)
Surgical necrotizing enterocolitis	38 (12.5%)	15 (2.9%)	27 (4.0%)
Intestinal perforation	17 (5.6%)	16 (3.1%)	19 (2.8%)
(missing)	4	0	0

significant differences were noted in demographic characteristics, maternal health and socioeconomic variables among those assessed and not assessed at age 15 (see Table 1). Given that anxiety and depressive disorders are highly comorbid with a significant overlap in symptoms, this combination can contribute to an increased risk of comorbid general medical illnesses, and worse treatment outcomes than with either condition alone (47–50), the combined variable, anxiety-and-depression, was an indicator of greater illness burden in our analyses at age 15 in the ELGAN cohort.

3.1 Maternal health characteristics at birth

3.1.1 Univariate analyses

Maternal hypertension was significantly associated with symptoms of anxiety and depression in youth at age 15. Specifically, hypertensive disorder during pregnancy was linked with depression (OR: 1.59, 95% CI: 1.00, 2.50). A discharge diagnosis of hypertensive disorder in the mother was associated with anxiety (OR: 1.68, 95% CI: 1.03, 2.67), which was noted in females (OR: 1.81, 95% CI: 1.03, 3.15) but not males. Another maternal health characteristic of significance was pre-pregnancy BMI. In female participants, maternal obesity displayed significant relationships with anxiety (OR: 1.86, 95% 95% CI: 1.03, 3.38), depression (OR: 2.57, 95% CI: 1.33, 5.02), anxiety-or-depression (OR 1.95, 95% CI 1.10, 3.46), and anxiety-and-depression variables (OR 2.9, 95% CI 1.36, 3.61). Maternal smoking during pregnancy was associated with depression (OR 1.73, 95% CI 1.01, 2.87), and anxiety-and-depression (OR: 2.00, 95% CI: 1.06, 3.61). Maternal exposure to second-hand smoke was also associated with depression (OR: 1.73, 95% CI: 1.10, 2.68) and anxiety-and-depression (OR: 1.79, 95% CI: 1.03, 3.03) in the overall sample. This was also noted in females whose mothers were exposed to secondhand smoke with presence of depression (OR: 2.26, 95% CI: 1.26, 4.00) and anxiety-and-depression (OR: 2.76, 95% CI: 1.45, 5.24; see Table 2 and Supplementary Table 2A and 2B for sex differences in outcome variables).

3.1.2 Multivariable analyses

Mothers who were overweight (BMI: 25.0–29.9) had youth with higher odds of anxiety (aOR: 1.82, 95% CI: 1.12, 2.95) when adjusted for insurance/Medicaid and maternal education. Mothers who were classified as being obese (BMI > 30) had youth with higher odds of anxiety (aOR: 1.84, 95% CI: 1.15, 2.94), depression (aOR: 1.95, 95% CI: 1.17, 3.23), and anxiety-and-depression (aOR: 1.77, 95% CI: 0.94, 3.32). Female youth who had mothers with BMI > 30 were more likely to have depression (OR: 2.44, 95% CI: 1.23, 4.88) and anxiety-and-depression (aOR: 2.58, 95% CI: 1.17, 5.82) when adjusted for Medicaid and maternal education. In male youth, anxiety symptoms were associated with overweight status in mothers (aOR: 2.27, 95% CI: 1.07, 4.75) when adjusted for Medicaid and maternal education. When adjusted for Medicaid status, maternal education and marital status of the mother, smoke exposure (active and second-hand smoke exposure combined) was associated with depression (aOR: 1.8, 95% CI: 1.08, 3.00) and anxiety-and-depression (aOR: 2.83, 95% CI: 1.51, 5.31).

3.2 Maternal socioeconomic characteristics

3.2.1 Univariate analyses

Youth whose mother had a high school education were more likely to have anxiety-and-depression (OR: 2.46, 95% CI: 1.03, 6.84) than those with less than college education or higher with stronger associations noted in females (OR: 6.27, 95% CI: 1.70, 40.6). Mothers who did not have a college degree were also more

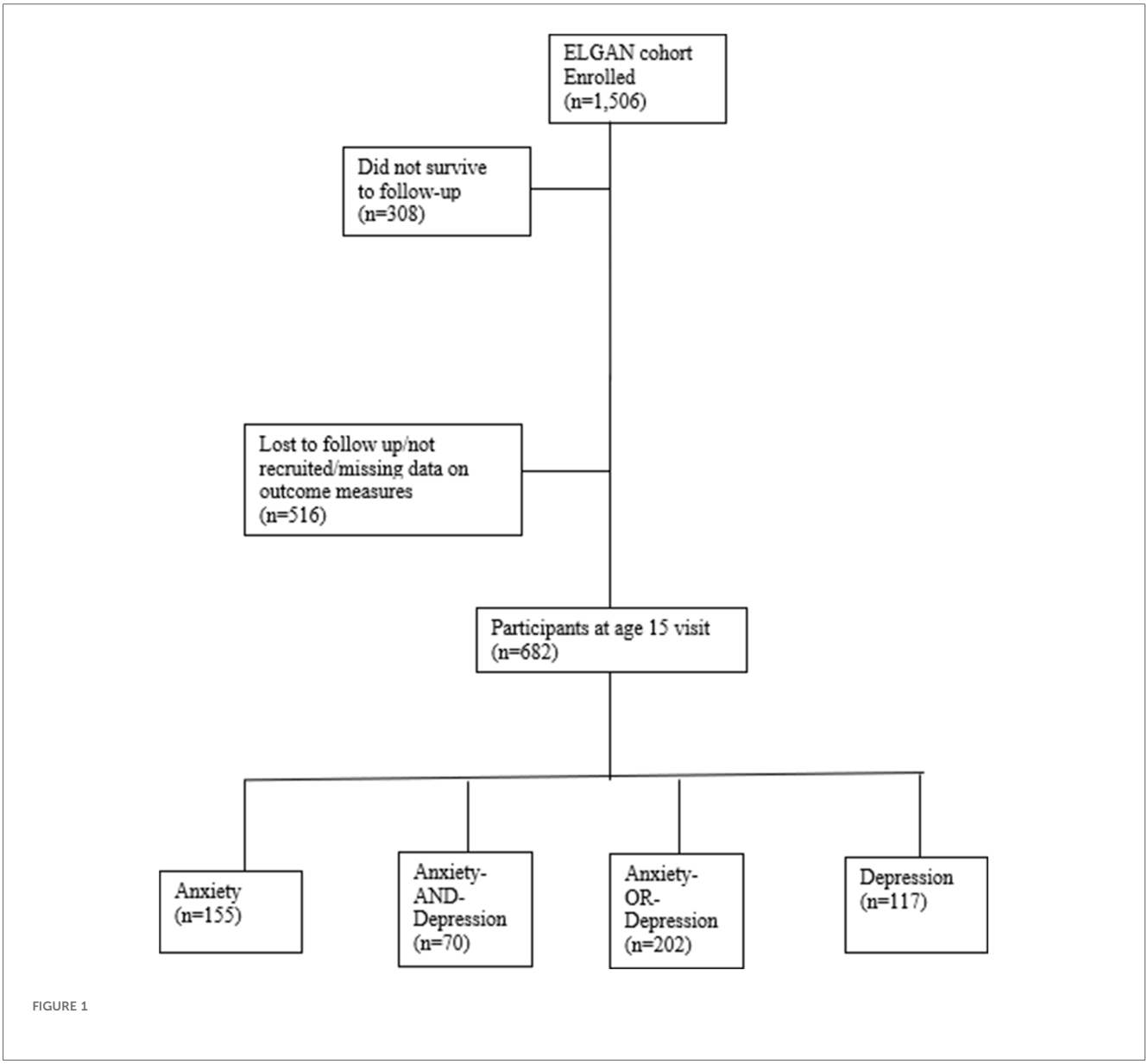

FIGURE 1

likely to have female children with depression (OR: 1.86, 95% CI: 1.04, 3.45) and anxiety-and-depression (OR: 2.26, 95% CI: 1.13,4.82). Female youth whose mothers were on Medicaid displayed greater likelihood for the development of anxiety (OR: 1.71, 95% CI: 1.04, 2.81) while males had decreased likelihood for the presence of anxiety-and-depression (OR: 0.19, 95% CI: 0.03, 0.67; see Table 3 and Supplementary Table 3A and 3B for sex differences in outcome variables).

3.2.2 Multivariable analyses

When adjusted for maternal age, no statistically significant associations were noted between maternal marital status, maternal education and outcomes of anxiety and/or depression in the overall sample as well as in females and males. When adjusted for marital status, maternal age and maternal education, there were no significant associations noted with Medicaid/insurance status.

3.3 Maternal childhood trauma history

3.3.1 Univariable analyses

Mother's childhood experience of parental upheaval, defined as experiencing parental separation or divorce, was associated with anxiety-and-depression (OR: 1.91, 95% CI: 1.01, 3.55) in both male and female adolescents, and was associated with anxiety among male adolescents (OR: 2.26, 95% CI: 1.08, 4.65). Maternal childhood exposure to sexual trauma was associated with anxiety-and-depression in female adolescents (OR: 2.55, 95% CI: 1.12, 5.67). Mothers who were victims of violence in childhood were more likely to have adolescents with anxiety (OR: 2.4, 95% CI: 1.22, 4.62), and anxiety-and-depression (OR: 2.49, 95% CI: 1.05, 5.42). In the analysis by sex, this association was only seen in the male offspring. Other upheaval, defined as any other experience or upheaval that may have shaped the reporter's life or personality significantly,

TABLE 2 Maternal health characteristics at birth: univariate and multivariate associations with adolescent anxiety, depression, anxiety-or-depression, and anxiety-and-depression.

Characteristic	Anxiety		Depression		Anx. OR Dep.		Anx. AND Dep.	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Pre-pregnancy asthma	1.13	0.66, 1.87	1.29	0.72, 2.22	1.04	0.63, 1.68	1.62	0.81, 3.01
Pre-preg diabetes	1.34	0.47, 3.37	1.54	0.49, 4.02	1.46	0.57, 3.53	1.46	0.34, 4.46
Pre-preg high blood pressure	1.08	0.49, 2.18	1.39	0.61, 2.89	1.23	0.62, 2.37	1.22	0.41, 2.95
Pregnancy-induced hypertension	1.28	0.78, 2.05	1.16	0.66, 1.97	1.25	0.79, 1.95	1.22	0.60, 2.28
Preeclampsia	1.56	0.88, 2.67	1.16	0.59, 2.14	1.41	0.83, 2.37	1.37	0.61, 2.77
Discharge diagnosis of Hypertensive disorder	**1.68**	**1.03, 2.67**	1.65	0.97, 2.73	**1.69**	**1.07, 2.63**	1.79	0.94, 3.24
HELLP syndrome	1.04	0.40, 2.35	2.16	0.92, 4.71	1.4	0.63, 2.95	1.81	0.59, 4.52
Hypertensive disorder during pregnancy	1.49	0.97, 2.25	**1.59**	**1.00, 2.50**	**1.54**	**1.04, 2.28**	1.64	0.92, 2.82
Prepreg BMI								
Healthy Weight	—	—	—	—	—	—	—	—
Under Weight	1.49	0.71, 2.97	1.26	0.52, 2.75	1.61	0.82, 3.05	1.02	0.29, 2.76
Over Weight	**1.84**	**1.14, 2.95**	1.55	0.89, 2.63	**1.71**	**1.09, 2.66**	1.85	0.96, 3.46
Obese	**1.87**	**1.19, 2.92**	**1.94**	**1.19, 3.16**	**2.08**	**1.37, 3.14**	1.78	0.96, 3.25
Smoke while pregnant	1.43	0.86, 2.31	**1.73**	**1.01, 2.87**	1.42	0.89, 2.24	**2.00**	**1.06, 3.61**
Second-hand smoke exposure	1.10	0.72, 1.68	**1.73**	**1.10, 2.68**	1.22	0.82, 1.79	**1.79**	**1.03, 3.03**
Active or Second-hand Smoke Exposure	1.19	0.79, 1.77	**1.8**	**1.17, 2.75**	1.26	0.86, 1.81	**2.03**	**1.20, 3.37**
Multivariate analyses								
Pre-pregnancy asthma Adjusted for Medicaid, Maternal education	1.08	0.62, 1.81	1.14	0.62, 1.99	0.98	0.58, 1.60	1.41	0.69, 2.70
Pre-pregnancy diabetes Adjusted for Medicaid, maternal education, maternal BMI	1.06	0.36, 2.72	1.18	0.37, 3.20	1.1	0.42, 2.72	1.17	0.26, 3.73
Maternal hypertension combined variable Adjusted for Medicaid, maternal education, maternal BMI, maternal smoke exposure	1.57	0.97, 2.51	1.57	0.97, 2.51	1.46	0.96, 2.20	1.51	0.83, 2.66
Prepreg Body Mass Index: Adjusted for Medicaid, maternal education								
Healthy Weight	—	—	—	—	—	—	—	—
Under Weight	1.46	0.69, 2.93	1.2	0.49, 2.64	1.51	0.76, 2.90	1.04	0.29, 2.85
Over Weight	**1.82**	**1.12, 2.95**	1.49	0.85, 2.55	**1.71**	**1.08, 2.68**	1.71	0.88, 3.26
Obese	**1.84**	**1.15, 2.94**	**1.95**	**1.17, 3.23**	**2.08**	**1.35, 3.20**	**1.77**	**0.94, 3.32**
Active or Second-hand Smoke Exposure	1.11	0.68, 1.78	**1.8**	**1.08, 3.00**	1.03	0.66, 1.58	**2.83**	**1.51, 5.31**

OR, odds ratio, CI, confidence interval; HELLP, Hemolysis, Elevated Liver enzymes and Low Platelets.
Variables adjusted for analyses: pre-pregnancy asthma, pre-pregnancy diabetes, maternal hypertension adjusted variable, pre-pregnancy body mass index, active or second-hand smoke exposure. Statistically significant associations are in bold.

was associated with anxiety-and-depression in the overall sample (OR: 2.21, 95% CI: 1.04, 4.44), and anxiety (OR: 3.21, 95% CI: 1.30, 7.68) and anxiety-and-depression (OR: 5.83, 95% CI: 1.80, 18.0) in males. See Table 4 describing maternal childhood trauma characteristics with univariate associations with adolescent anxiety or depression with overall sample, female and male participants.

3.3.2 Multivariable analyses with severity of traumatic experiences

When adjusted for maternal age and CTQ severity rating, mothers who were exposed to smoke (active and secondhand smoke exposure) had a greater likelihood of having children with anxiety-and-depression (OR: 3.26, 95% CI: 1.39, 7.63). When adjusting for CTQ severity, mothers whose marital status was classified as not ever married, living together, had a greater likelihood of having children with anxiety-and-depression at age 15 years (aOR: 029, 95% CI: 0.07, 0.85).

4 Discussion

Children born extremely preterm are at a higher risk of psychiatric disorders in adolescence, notably anxiety and depression (4, 26, 51). We sought to identify modifiable prenatal and early-life risk factors of these highly prevalent conditions in this already vulnerable population by examining associations between youth's psychiatric diagnoses of anxiety and depression and measures of maternal health, socioeconomic factors, and maternal report of childhood trauma in this study. Our study assessed for sex differences for anxiety and depression in the youth born extremely preterm and noted the findings are consistent with sex differences in the prevalence of psychiatric disorders reported in adolescents in epidemiologic studies in the general population (4, 52, 53).

We noted that maternal health attributes of hypertension, elevated BMI (overweight or obese status), and smoke exposure (active or secondhand smoke) were associated with the presence of anxiety and depression in the youth. After adjusting for maternal education and Medicaid status, elevated maternal BMI continued

TABLE 3 Maternal socioeconomic characteristics at birth: univariate and multivariable associations with adolescent anxiety, depression, anxiety-or-depression, and anxiety-and-depression.

Characteristic	Anxiety		Depression		Anx. OR Dep.		Anx. AND Dep.	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Marital status								
Married	—	—	—	—	—	—	—	—
Separated/Divorced/Widowed	1.97	0.84, 4.36	1.5	0.53, 3.63	1.81	0.80, 3.97	1.75	0.57, 4.48
Never married, living together	0.64	0.36, 1.09	1.35	0.79, 2.26	1.2	0.76, 1.87	0.44	0.16, 0.97
Never married, not living together	1.13	0.67, 1.85	1.01	0.54, 1.79	1.32	0.82, 2.09	0.68	0.29, 1.40
Married	1.05	0.72, 1.54	0.8	0.53, 1.21	0.76	0.54, 1.06	1.51	0.88, 2.68
Education								
Less than High School	—	—	—	—	—	—	—	—
High School	1.2	0.66, 2.25	1.26	0.66, 2.49	0.94	0.54, 1.65	**2.46**	**1.03, 6.84**
Less than college	0.89	0.48, 1.70	0.76	0.38, 1.56	0.67	0.38, 1.19	1.43	0.56, 4.15
College	0.87	0.46, 1.66	0.84	0.42, 1.72	0.73	0.41, 1.30	1.28	0.48, 3.76
More than college	0.91	0.47, 1.78	0.67	0.31, 1.44	0.65	0.35, 1.18	1.34	0.49, 4.03
Without College Degree	1.17	0.81, 1.70	1.32	0.87, 2.02	1.21	0.86, 1.72	1.32	0.79, 2.25
Insurance: Medicaid	1.25	0.85, 1.81	1.27	0.83, 1.92	**1.47**	**1.04, 2.07**	0.93	0.53, 1.56
Support: Food Stamps	0.99	0.54, 1.73	1.39	0.74, 2.46	1.23	0.73, 2.04	1.05	0.45, 2.16
Multivariable analyses								
Marital Status Adjusted for maternal age								
Separated/Divorced/Widowed	1.97	0.84, 4.36	1.5	0.53, 3.63	1.81	0.80, 3.97	1.75	0.57, 4.48
Never married, living together	0.64	0.36, 1.09	1.35	0.79, 2.26	1.2	0.76, 1.87	0.44	0.16, 0.97
Never married, not living together	1.13	0.67, 1.85	1.01	0.54, 1.79	1.32	0.82, 2.09	0.68	0.29, 1.40
Married	—	—	—	—	—	—	—	—
Education Adjusted for maternal age								
Less than High School	—	—	—	—	—	—	—	—
High School	1.16	0.62, 2.20	1.22	0.63, 2.46	0.93	0.53, 1.64	2.26	0.92, 6.40
Less than college	0.84	0.43, 1.66	0.72	0.35, 1.55	0.65	0.35, 1.20	1.25	0.46, 3.77
College	0.8	0.40, 1.61	0.78	0.37, 1.69	0.7	0.38, 1.32	1.07	0.38, 3.33
More than college	0.83	0.40, 1.72	0.61	0.27, 1.40	0.61	0.32, 1.19	1.11	0.38, 3.53
Insurance: Medicaid Adjusted for marital status, maternal age, maternal education	1.3	0.76, 2.23	1.1	0.61, 1.99	1.33	0.81, 2.17	1.03	0.49, 2.13

OR, odds ratio; CI, confidence interval.
Statistically significant associations are in bold.

to be significantly associated with anxiety and depression in adolescents. In contrast to earlier findings from our group that did not find an association between smoke exposure and cognitive outcomes at age 10 (41), we noted that smoke exposure even after statistical adjustment for Medicaid, maternal education and marital status remained associated with psychiatric outcomes at age 15. Exposure to maternal metabolic disorders during pregnancy, including hypertension and obesity, has been linked to adverse outcomes in the behavior and physiology of their offspring, and the development of neuropsychiatric disorders such as anxiety and depression (54–57). High maternal BMI increases the risk of adverse childhood outcomes including preterm and extreme preterm birth as well as likelihood of high or low birth weight (58, 59), which in turn increases the risk of the development of anxiety and depression in adolescence (4). A comprehensive meta-analysis by Zhang and colleagues also demonstrated associations between maternal pre-pregnancy overweight status/obesity and adverse neurodevelopmental outcomes in their offspring including anxiety, depression, emotional symptoms, autism spectrum disorder among others. Obesity during pregnancy can have an impact on neuroendocrine, metabolic and inflammatory systems leading to altered neuronal plasticity, impaired reward circuitry, and dysregulated brain metabolism (60–62). Additionally, due to disturbances in metabolic and endocrine factors in adipose tissue in obesity, there is an increased risk of insulin resistance which can increase the risk for the development of type 2 diabetes (63, 64). A nationwide cohort study in Finland (65) found that maternal moderate and severe obesity along with type 2 diabetes and pregestational diabetes were associated with development of mood disorders in their children. The association of severe obesity in combination with diabetes had a stronger link with psychiatric and neurodevelopmental outcomes in this study, suggesting a stronger neural exposure to inflammation, oxidative stress, lipotoxicity and insulin resistance. In the Avon Longitudinal Study for Parents and Children (ALSPAC), hypertensive pregnancy disorders in mothers predicted a significantly greater risk of anxiety and depression in children at age 7 and age 15 respectively (66). In another large cohort study, maternal smoking in early pregnancy was associated with childhood internalizing symptoms of anxiety and depression (67). It has been hypothesized based on

TABLE 4 Maternal childhood trauma characteristics: univariate associations with adolescent anxiety or depression with overall sample, female and male participants.

Characteristic	Anxiety		Depression		Anx. OR Dep.		Anx. AND Dep.	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Overall sample								
Death of friend/family	0.87	0.55, 1.37	1.16	0.70, 1.91	1.1	0.73, 1.67	0.78	0.41, 1.44
Parent Upheaval	1.5	0.93, 2.42	1.48	0.86, 2.51	1.37	0.87, 2.14	**1.91**	**1.01, 3.55**
Sexual trauma	1.6	0.93, 2.70	1.66	0.92, 2.93	1.57	0.95, 2.58	1.91	0.94, 3.69
Victim Violence	**2.4**	**1.22, 4.62**	1.78	0.82, 3.63	**2.04**	**1.06, 3.89**	**2.49**	**1.05, 5.42**
Illness/Injury	0.69	0.25, 1.62	0.83	0.27, 2.05	0.59	0.23, 1.33	1.13	0.32, 3.03
Other Upheaval	1.46	0.80, 2.61	1.76	0.91, 3.26	1.38	0.78, 2.40	**2.21**	**1.04, 4.44**
Female								
Death of friend/family	1.04	0.57, 1.88	0.84	0.42, 1.65	1.06	0.60, 1.87	0.77	0.35, 1.65
Parent Upheaval	1.08	0.56, 2.03	1.77	0.87, 3.53	1.16	0.62, 2.12	1.8	0.81, 3.88
Sexual trauma	1.56	0.78, 3.08	2.05	0.96, 4.26	1.45	0.73, 2.80	**2.55**	**1.12, 5.67**
Victim Violence	1.62	0.61, 4.06	1.72	0.58, 4.55	1.55	0.60, 3.84	1.96	0.60, 5.47
Illness/Injury	0.51	0.12, 1.64	0.86	0.19, 2.78	0.4	0.09, 1.27	1.26	0.28, 4.17
Other Upheaval	0.77	0.32, 1.69	1.38	0.57, 3.10	0.94	0.43, 1.96	1.15	0.40, 2.86
Male								
Death of friend/family	0.7	0.34, 1.40	1.74	0.82, 3.78	1.17	0.63, 2.15	0.82	0.27, 2.36
Parent Upheaval	**2.26**	**1.08, 4.65**	1.13	0.47, 2.55	1.64	0.83, 3.17	2.00	0.64, 5.83
Sexual trauma	1.54	0.63, 3.50	1.14	0.40, 2.85	1.67	0.76, 3.54	0.73	0.11, 2.80
Victim Violence	**3.82**	**1.45, 9.83**	1.88	0.58, 5.25	**2.75**	**1.08, 6.92**	**3.81**	**0.97, 12.6**
Illness/Injury	0.98	0.22, 3.23	0.78	0.12, 2.99	0.89	0.24, 2.67	0.86	0.05, 4.74
Other Upheaval	**3.21**	**1.30, 7.68**	2.34	0.84, 5.95	2.2	0.92, 5.11	**5.83**	**1.80, 18.0**

animal models, that exposure to nicotine and other components of cigarette smoke may interfere with neurodevelopmental processes *in utero*, thus leading to this increased risk (68, 69); however, no direct causal relationship between these factors has been demonstrated in human studies (67).

The link between SES and child mental health and wellbeing is well established in multiple population-based studies (70, 71). We also noted an association between lower maternal education and greater prevalence of anxiety at age 15, but this did not persist when adjusted for maternal age. Studies have examined the psychophysiological pathways underlying this association which have suggested that exposure to chronic stressful events secondary to low SES and long-term alterations in physiological systems make individuals more vulnerable to anxiety, depression and aberrant hypothalamic-pituitary-adrenal (HPA) axis functioning (McEwen, 2000). Receipt of public health insurance was additionally used as an estimate of socioeconomic disadvantage in the ELGAN cohort. Similar to our results, other longitudinal studies involving youth exposed to poverty and socioeconomic disadvantage were noted to have increased prevalence of symptoms of anxiety and depression in adolescence (72, 73).

Parental mental health plays a critical role in the child's physiological as well as psychological response to stress (71). Exposure to childhood trauma can lead to altered emotional and behavioral response patterns that often persist into adulthood and thus negatively impact caregiving (36, 74). Maternal report of a history of childhood trauma has been linked to mood and anxiety disorders, posttraumatic stress disorder, and other significant mental health conditions in their children (75–78). This critical public health implication was noted in our studied sample as well, as mothers who were exposed to traumatic events in their childhood were more likely to have children diagnosed with anxiety and depression in adolescence. Specifically, the association between mothers exposed to parental upheaval, sexual trauma or being victims of any other traumatic event, and the presence of anxiety and depressive symptoms in the adolescent was significant in both biological sexes. Maternal social isolation, dysfunction in intimate relationships, academic and social challenges may occur as downstream effects of a traumatic exposure in childhood and can impact access to healthcare and other resources for the child and family (35, 79–81). Surprisingly, the severity of childhood trauma experienced by the mother did not significantly alter the associations between perinatal factors and socioeconomic status and anxiety and/or depression outcomes. In our sample, it is important to consider the role of extreme preterm birth, the associated stressors related to medical investigations, interventions and monitoring, the child's co-occurring medical diagnoses and any signs of distress and helplessness that they may display, which could serve as traumatic reminders for mothers who report having experienced childhood trauma (82). This could lead to an added increased risk of insensitive caregiving, child maltreatment and long-term impact on mother-child relationships and maladaptive interaction styles, in part due to the mother's own impaired self-regulation abilities (34, 51, 82, 83).

5 Strengths and limitations

In addition to its prospective, longitudinal design with recruitment of a large number of children who were born

extremely preterm, our study is unique in the use of a structured diagnostic interview to evaluate symptoms of anxiety and depression in adolescents at age 15. Information about maternal health was obtained by self-report leading to concerns about inaccurate reporting and the resultant misclassification bias could lead to an underestimation of the strength of associations with those health disorders (84). We have previously reported that in the ELGAN cohort some adolescents who had anxiety and depression symptoms on dimensional measures did not meet the clinical threshold for the diagnosis on the MINI-KID. This suggests that the interview does not fully capture subclinical symptoms in our study population (4). Another limitation of our study is the relatively high attrition rate at age 15 years, similar to that noted in other longitudinal studies (85). It is also important to consider the impact of our selected study population of extreme preterm infants where effects of maternal factors on the development of anxiety and depression may be underestimated since the study design controls for gestational age.

In addition, we do not have information on parental attachment styles in our analysis, making it difficult to assess the extent of emotional dysregulation's impact on anxiety and depression compared to other presented factors. A methodologic concern with including parental psychopathology as a confounder in our analyses is that ascertainment of parent psychiatric diagnoses was completed simultaneous with ascertainment of child's psychiatric diagnoses. It is possible that any symptoms of parental psychopathology reported at age 15 may not have been present at birth for all participants and may have arisen due to associated stressors related to EP birth, associated medical and psychiatric comorbidities in the child and accurate date regarding the timeline of the onset of symptoms in the parent was not available. Only data on maternal psychiatric diagnoses was available for a subset of the sample and we did not have paternal psychiatric diagnostic information on all youth. Similarly, our inclusion of maternal report of early life trauma obtained when adolescents were 15 years of age is not in temporal alignment with our other early life indicators. While we believe this variable is an important consideration in examining the psychiatric status of our adolescent sample, the ascertainment of this information in a retrospective manner may have biased our data in an unknown fashion, and follow-up of the influence of this variable for this population of adolescents remains a future area of scientific inquiry into modifiable maternal factors.

6 Conclusions

The current study underscores the importance of monitoring for psychiatric disorders, especially anxiety and depression, in children born extremely preterm. Maternal health conditions including exposure to smoke and elevated BMI were noted to be associated with the development of anxiety and depression in their child in adolescence. Additionally, socioeconomic stressors and maternal childhood trauma were independently associated with symptoms of anxiety and depression in these youth born extremely preterm. Identification of these modifiable risk factors serves to inform future research efforts and the design of interventions to effectively address these challenging and prevalent conditions in preterm children. These findings set the stage for further work aimed at identifying mediating pathways between maternal childhood traumatic exposures and social determinants of health and child mental health outcomes in adolescents who are vulnerable.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by IRB of all participating institutions. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

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Acceptance and commitment therapy group protocol for caregivers of anxious youth: an open trial pilot study

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Introduction: Anxiety disorders are common, distressing, and impairing for children and families. Cognitive-behavioral interventions targeting the role of family interactions in child anxiety treatment may be limited by lack of attention to antecedents to parental control; specifically, internal parent factors such as experiential avoidance and cognitive fusion. This pilot study evaluates the preliminary efficacy of a group-delivered caregiver treatment program, ACT for Parents of Anxious Children (ACT-PAC) that targets parental experiential avoidance, cognitive fusion, and child internalizing symptoms.
Methods: Twenty-three youth ages 7–17 years with a primary anxiety disorder diagnosis and their primary caregiver participated in six one-hour, weekly group treatment sessions. Parents and children reported on child symptomatology and parents reported on parent symptomatology and quality of life at two assessment points: within one week before ACT-PAC treatment and within one week after treatment. Parents self-reported on parental internal processes specifically targeted by ACT (e.g., cognitive fusion) weekly during the 6-week treatment.
Results: Results support the feasibility and acceptability of ACT-PAC and indicate reductions in parents' cognitive fusion and child internalizing symptoms.

KEYWORDS

child anxiety, acceptance and commitment therapy, parenting, child internalizing problems, cognitive fusion

1 Introduction

Anxiety disorders are the most commonly experienced mental health problems for children under 18, affecting up to 20% of youth (1, 2) and representing an early low-degree expression of successive, more severe mental health problems (3–7). While empirically supported treatments for child anxiety exist, up to 40% of children show minimal improvement following treatment (8). Given that treatment-interfering parent-child interactions, specifically parental control or lack of autonomy-granting (9, 10) have been found to characterize anxiety affected families (11), parenting behavior represents a promising target for improving treatment outcomes. However, research aimed at enhancing psychotherapy outcomes by involving parents in treatment has generally been disappointing (12).

Most parent-focused interventions for childhood anxiety have one notable limitation in that they have assumed that parents have the psychological flexibility to make behavior

changes, such that they are able to engage in flexible patterns of behavior that support their learning more effective parenting strategies (13). Existing interventions have largely been instructive—coaching parents, for instance, on how to be more involved in treatment, training them to serve as lay CBT therapists, or teaching generic parenting skills [e.g., (14, 15)]. Even the few interventions that have directly targeted parental responses to child anxiety (e.g., The Space Program; (16); Family-Based Cognitive-Behavioral Therapy; (17)) and that have been effective in comparison to active control treatments (18) and non-inferior to child-based Cognitive Behavioral Therapy (19) lack attention to the psychological barriers, such as experiential avoidance [parents attempt to reduce their own emotional reactivity or distress upon seeing their child anxious; (20)] and cognitive fusion [parents responding to their thoughts as literal content; (21)] that might interfere with parents implementing recommended behavioral changes.

Acceptance and Commitment Therapy [ACT; (22)], a treatment model which incorporates mindfulness and acceptance, has substantial promise for enhancing behavior change in parents as a means of improving treatment outcomes for anxious youth (23). ACT is grounded in relational frame theory and as such highlights the role of language and verbal experiences in unhelpful behavioral processes. The efficacy of ACT has been well-documented for a variety of psychological conditions in adults (24–26) and shows promise for alleviating symptoms of mental health problems in youth, including those with anxiety disorders. Swain et al. (27) conducted a randomized controlled trial of ACT and CBT for anxious children; both treatments used a "parent-as coach" approach, teaching parents the same therapeutic skills children were learning. Children in both ACT and CBT groups showed reductions in clinical severity and symptom ratings (28), with gains maintained at three-month follow-up. While promising, the intervention did not directly target or measure parent psychological flexibility as a variable that may impact the ability to respond effectively to one's anxious child. Several ACT protocols have been designed and tested specifically for parents of youth with chronic physical [e.g., cerebral palsy; (29)] or psychological conditions [e.g., autism (30, 31) and aggression[1]] and have shown success in improving parent adjustment, well-being, and psychological flexibility (31) Given the role of parent behavior in pediatric anxiety disorders, and in light of evidence pointing to the utility of parent-focused ACT in improving psychological symptoms in children and psychological well-being and flexibility in parents, the present study piloted a group-delivered ACT for Parents of Anxious Children (ACT-PAC) protocol (see text footnote 1); the protocol is freely available to the Association for Contextual Behavioral Science community) that would serve as an adjunctive treatment to child-alone treatment for anxiety. The primary aim of this study was to evaluate the feasibility and acceptability of ACT-PAC. Our second, exploratory aim, was to assess within-subject change in (1) child symptomatology, (2) parent internal processes specifically targeted by ACT, namely experiential avoidance and cognitive fusion, and (3) parent symptomatology and quality of life.

2 Methods and materials

2.1 Participants

Twenty three youth ages 7–17 years (14 males, 9 females; mean age 12.7) and their primary caregiver (20 mothers, 3 fathers, mean age 45 years) participated in this study. All participants were European American. Parents were highly educated, with 17% completing some college, 48% completing college, and 26% reporting post college education (education was not reported for 2 participants). All children had a primary anxiety disorder diagnosis as determined by the ADIS-C/P (The Anxiety Disorders Interview Schedule-Child and Parent version), and most common diagnoses were Specific Phobia (96%), Generalized Anxiety Disorder (52%), Obsessive-Compulsive Disorder (48%), Social Phobia (43%), and Separation Anxiety Disorder (22%). At study entry, 73% of children were taking psychiatric medication and 70% of children were engaged in psychotherapy.

2.2 Procedure

Thirteen participants were recruited using flyers that targeted parents with a child struggling with anxiety or parents struggling to help their child cope with anxiety. Flyers were posted at a university based Pediatric OCD and Anxiety Disorders Clinic and advertised a 6-week parenting group and child anxiety assessment. Two participants were on the waitlist to begin treatment at the Pediatric OCD and Anxiety Disorders Clinic and were offered the opportunity to participate in this study while they awaited treatment. Eight participants were recruited through community therapist referrals, in which community therapists were asked by the research team to make referrals to parents looking for additional ways to support their child with anxiety. Families who expressed interest completed a brief phone screen about the child's anxiety diagnosis, treatment, and symptoms. Those who reported a previous anxiety disorder diagnosis, current or previous therapy for anxiety-related concerns, and/or high interference caused by anxiety symptoms participated in a diagnostic assessment using the Anxiety Disorders Interview Schedule for DSM-IV: Child and Parent Version (ADIS-C/P). Based on the results of the ADIS-/CP, study clinicians determined whether children met criteria for the study, which required having a primary anxiety disorder diagnosis (diagnosis causing the most functional interference; children could have comorbid diagnoses). The following diagnosis met inclusion criteria: generalized anxiety disorder, obsessive-compulsive disorder, specific phobia, social anxiety

[1]Coyne LW. *ACT for Parents*. Department of Psychology, Suffolk University (2014).

disorder, separation anxiety disorder and agoraphobia. Comorbid diagnoses included persistent depressive disorder, major depressive disorder, ADHD inattentive type, ADHD combined type, and oppositional defiant disorder. Children were excluded if they needed inpatient services, were diagnosed with psychosis or if they experienced a new onset of suicidal ideation. Parents were excluded if they experienced a new onset of suicidal ideation. All procedures were approved by the University of Massachusetts Chan Medical School Institutional Review Board.

2.2.1 Assessment schedule

We used a within-subject repeated measures design with two assessment points: within one week before ACT-PAC treatment (pre-treatment) and within one week after treatment (post-treatment). The ACT Parenting Measure and Cognitive Fusion Questionnaire (CFQ) were administered at pre-treatment, post-treatment, and weekly during the 6 week treatment. While parents completed their questionnaires, children who requested help with reading the questionnaires were given assistance by the study coordinator. Participating families were given $20 for each assessment (pre-treatment, post-treatment). See Table 1 for a list of study measures.

2.2.2 Intervention

Four groups of 6–7 parents participated in six one-hour, weekly group treatment sessions adapted from a more general ACT protocol, ACT for Parents (see text footnote 1). Groups were created based on date of enrollment, with each group launching after 6–7 participants were enrolled in the study. The ACT for Parents of Anxious Children Protocol (ACT-PAC) targeted psychological processes (e.g., cognitive fusion, experiential avoidance) hypothesized to impede parents from reducing behavior known to contribute to child anxiety (e.g., intrusiveness/restriction of autonomy). Treatment modules focused on mindfulness, cognitive defusion, acceptance, values, committed action, and self-care in the context of parenting a child with an anxiety disorder. (See Table 2 for additional information on intervention components).

The intervention was specifically modified for parents of anxious children in two meaningful ways. First, content was dedicated to helping parents understand the impact of anxiety on parenting. Using experiential exercises and discussion, parents practiced accepting their own emotional reactions (e.g., anxiety, anger, frustration, exhaustion, etc.), defusing from catastrophic thoughts, and noticing unhelpful verbal rules (e.g., "Good parents do not allow their child to become distressed") in response to their child's anxiety. Parents were also encouraged to reflect on the reactive behavioral solutions they had undertaken to alleviate their own discomfort when the child was anxious, which included rescuing the child, engaging in avoidance, accommodating or taking over all or part of the child's experience, chiding or punishing the child, or ignoring/invalidating or minimizing their anxious child's experience. In reflecting on these behavioral impulses, parents considered whether these behavioral impulses moved them towards or away from their own parenting values.

A second modification to the ACT-PAC protocol included content focused on supporting parents in using ACT to connect with their own parenting values when anxiety is present. Parents practiced making space for the discomfort that arose when their child was anxious, and making mindful behavioral choices. In doing so, parents thought deeply about how they could stay connected to their parenting values even when upset by their child's distress, which often looked like allowing their child to learn to tolerate or accept anxiety and still do things they love. This gave parents the opportunity to practice taking committed action towards their values instead of reactively attempting to alleviate their child's discomfort.

2.3 Measures—parent report

Demographics Form. Parents completed demographic information, including parent/child gender, race/ethnicity, and age.

2.3.1 Parent functioning

Depression, Anxiety, and Stress Scale [DASS; (32)]. The DASS consists of 42 negative emotional symptoms of depression, anxiety, and stress. Parents rated the extent to which the symptom applied to them over the past week on a scale ranging

TABLE 1 Summary schedule of data collected.

Measure	Pre-treatment	Post-treatment	Weekly	Informant
Demographics form	X			Caregiver
Child behavior checklist	X	X		Caregiver
Screen for child anxiety related emotional disorders	X	X		Caregiver Youth
Depression, anxiety, and stress scale	X	X		Caregiver
Quality of life enjoyment and satisfaction questionnaire-short form	X	X		Caregiver
Multidimensional experiential avoidance questionnaire	X	X		Caregiver
Cognitive fusion questionnaire	X	X	X	Caregiver
ACT parenting measure	X	X	X	Caregiver
Parental acceptance questionnaire	X	X		Caregiver
Client satisfaction questionnaire		X		Caregiver
Qualitative feedback interview		X		Caregiver
Youth self report	X	X		Youth

TABLE 2 ACT for parents of anxious children intervention components.

Session number and title	Session objectives	Home practice
1. Mindfulness: finding stillness	Listening to parenting obstacles Noticing and normalizing parenting stress Introducing present moment awareness	Mindfulness in daily life
2. Defusion: weathering thoughts & feelings	Listening to difficult parenting thoughts & feelings Introducing how the mind works: Fusion, experiential avoidance & defusion	Defusion/Weathering parent-child interaction
3. The matrix: moving towards vs. moving away	Listening to challenging interactions with your child Introducing concept of workability/acceptance in parent-child interaction	Tracking towards (values-oriented) vs. away (experientially avoidant) behavior
4. Value/committed action: doing what matters	Listening to core parenting values Introducing valuing/committed action in parenting consistency	Practice parenting commitment
5. Parenting your anxious child	Common parent-child interaction patterns in anxiety-affected families Using ACT skills to change problematic patterns	Practice parenting commitment specific to autonomy granting and reducing anxious modeling
6. Self-care: there's only one you	Listening with compassion/Self-as-context (Defusing "failure" Creating a touchstone: Turning back to values/committed action	Keeping it going Making time for you

from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). Internal consistencies (coefficient alpha) for each scale for the DASS normative sample were: Depression 0.91; Anxiety 0.84; and Stress 0.90 (32).

Quality of Life Enjoyment and Satisfaction Questionnaire-Short Form [Q-LES-Q-SF; (33)]. The Q-LES-Q-SF is a 16-item rating scale which assesses satisfaction and functioning in the domains of social, leisure, household, emotional well-being, and physical in the past week. Parents rated items on a 5-point scale ranging from 1 (very poor) to 5 (very good). The internal consistency and test-retest coefficients of this questionnaire were 0.9 and 0.93, respectfully (34).

2.3.2 ACT-related parent measures

Multidimensional Experiential Avoidance Questionnaire [MEAQ; (35)]. The MEAQ is a 62-item measure of experiential avoidance or the unwillingness to remain in contact with distressing feelings, thoughts, memories or other private experiences (22). The measure consists of 6 subscales: behavioral avoidance (e.g., "I go out of my way to avoid uncomfortable situations"), distress aversion (e.g., The key to a good life is never feeling any pain"), repression/denial (e.g., "I am able to 'turn off' my emotions when I don't want to feel"), distraction/suppression (e.g., When something upsetting comes up, I try very hard to stop thinking about it"), and distress endurance (e.g., "I am willing to suffer for the things that matter to me"). Parents rated items on a 6-point scale ranging from strongly disagree to strongly agree. The MEAQ subscales have demonstrated internal consistency in a validation sample of community adulst, with alphas averaging .87 (36).

Cognitive Fusion Questionnaire [CFQ; (37)]. The CFQ is a 7-item rating scale which assesses cognitive fusion or the tendency for behavior to be overly regulated and dominated by cognitive events. The measure is scored as a total score, with higher numbers reflecting greater fusion (e.g., "My thoughts cause me distress or emotional pain"). Gillanders et al. (37) reported a Cronbach's alpha of.90 from a student and community sample and.92 from a sample of people with work stress.

ACT Parenting Measure: This brief 4-item measure, designed specifically for this study measured parental report over the past week of (1) parental perceptions of match between the past week's parenting behavior and their own parenting values, (2) the perceived impact of strong emotion on parenting, and (3) the perceived impact of negative thoughts on parenting.

Youth Functioning

Child Behavior Checklist [CBCL; (38)]. The CBCL is a 113-item standardized measure of children's emotional, behavioral, and social functioning. Items measured anxiety, social withdrawal, depression, obsession–compulsions, non-communicative behavior, hyperactivity, aggression and somatic complaints. Parents rated items on a scale ranging from 0 (note true) to 2 (very true or often true). Achenbach and Rescorla (38) report test-retest reliability (Pearson's r) of 0.8–0.94, and internal consistency (Cronbach's alpha) of 0.63–0.97.

Screen for Child Anxiety Related Emotional Disorders [SCARED; (39)]. The SCARED is a 41-item symptom inventory used to screen for anxiety disorders. Parents rated symptoms for children's panic disorder, generalized anxiety disorder, separation anxiety, social anxiety disorder, and school avoidance on a scale ranging from 0 (not true or hardly ever true) to 2 (very true or often true). Each subscale has shown internal consistency coefficient values ranging from .78 to .87 (39).

2.3.3 Acceptability measures

Client Satisfaction Questionnaire [CSQ-8; (40)]. The Client Satisfaction Questionnaire is a reliable and valid 8-item self-report questionnaire that yields a measure of satisfaction with treatment. The scale ranges from 4 to 32, with higher scores indicating increased treatment satisfaction.

Qualitative Feedback Interview. The Qualitative Feedback Interview is a brief interview designed specifically for this study consisting of seven open-ended questions. Administered to the participating caregiver, this interview gathered participants' (1) overall experience with the study, (2) perceived acceptability, strengths and weaknesses of the group treatment protocol, and (3) perceived acceptability and tolerability of the study assessments. The qualitative interview was designed to measure whether the participants found the intervention to be appropriate, fair, reasonable, and consistent with treatment expectations (41).

2.4 Measures—child report

2.4.1 Youth functioning

Child Behavior Checklist Youth Self Report [CBCL-YSR; (42)]. The YSR is a self-report measure of behavioral and emotional problems in youth ages 11–18. It contains 113 items and eight sub-scales that measure symptoms of withdrawn, somatic complaints, anxiety and depression, social problems, thought problems, attention problems, aggressive behavior, and delinquent behaviors (42). Achenbach and Rescorla (38) report test-retest reliability (Pearson's r) of 0.67–0.91, internal consistency (Cronbach's alpha) of 0.71–0.95, and inter-rater reliability with the CBCL of 0.57–0.88.

Screen for Child Anxiety Related Emotional Disorders [SCARED; (39)]. Children also completed the 41-item child-report version of the SCARED. All subscales had internal consistency coefficients ranging from .78 to .87 (39).

3 Analyses

Study data were collected and managed using REDCap electronic data capture tools hosted at UMass Chan Medical School (43, 44). Double-data entry was used; all data entry discrepancies were resolved by consensus agreement. Quantitative data were analyzed as the change in value over the study period using a linear mixed model that accounts for the random effects associated with the treatment cohort (that is, the measures for participants in the same treatment cohort are likely correlated) and repeated measures within participants. For most measures, "study period" refers to pre-treatment and post-treatment. For the CFQ and ACT Parenting Measure, assessments were completed each week in addition to pre- and post-treatment. All analyses were done using the R Project for Statistical Computing (45), with contributed packages "lme4" (46) and "ggplot2" (47). Though uncorrected *p*-values are presented, a correction for False Discovery Rate (48) was applied to account for multiplicity in testing. Confidence intervals were estimated using the "Wald" method. Effect size was estimated from the test statistic of the fixed effect as $t/\sqrt{df_{error}}$.

4 Results

4.1 Preliminary analyses

One parent exceeded the clinical cut-off for depression (with a score of 12 or greater on the DASS). Five parents exceeded the clinical cut-off for anxiety (with a score of 5 or greater on the DASS).

4.2 Main analyses

There were no significant changes from pre-treatment to post-treatment among the Parent Symptoms measures (see Table 2, Figure 1 and Figure 2A). The Cognitive Fusion Questionnaire (CFQ) Total score showed a 2 point reduction during the treatment period [95% CI: −3.7, −0.3; t(22) = −2.3, uncorrected $p = 0.03$]. The Distraction and Suppression scale of the MEAQ was 1.5 points lower post-treatement [95% CI: −3.5, 0.5; t(22) = −1.5, $p = 0.15$].

Neither the ACT Parenting Measure nor the CFQ Total Score showed a significant change from pre-treatment across the weekly training sessions: the ACT Parenting measure increased 0.1 points at each assessment [95% CI: −0.8, 0.29; t(22.8) = 1.1, $p = 0.3$]; while the CFQ Total Score decreased 0.17 points at each assessment (95% CI: −0.4, 0.1); t(21.4) = −1.3, $p = 0.2$) ([see Figure 3, of scores at each week). However, when restricted to only the pre-treatment and post-treatment assessments, the CFQ Total score showed a 2 point reduction during the treatment period [95% CI: −3.7, −0.3; t(22) = −2.3, $p = 0.03$].

There were no significant changes from pre-treatment to post-treatment among the Child Symptoms measures (see Table 3 and Figure 2A). Modest effects (uncorrected *p*-values <0.1) were seen as the parent-rated CBCL t-scores for Internalizing symptoms were 1.8 points lower post-treatment [95% CI: −3.8, 0.1; t(22) = −1.8, $p = 0.08$] and the Obsessive Compulsive Disorder symptoms were 2.8 points lower post-treatment [95% CI: −5.7, 0.2; t(22) = −1.8, $p = 0.08$]. The child-rated YSR t-score for Obsessive Compulsive Disorder symptoms was also lower by 2.3 points [95% CI: −4.2, −0.4; t(3.1) = −2.3, $p = 0.10$].

Parent-rated scores on the SCARED were generally lower post-treatment than the child-rated scores. Though there were no significant differences between pre-treatment and post-treatment ratings, the Generalized Anxiety Disorder score was reduced on the parent-rated SCARED [−1.7 points, 95% CI: −3.5, 0.1; t(2.9) = −1.9, $p = 0.16$], but increased on the Child-rated SCARED [1.3 points, 95% CI: −0.2, 2.8; t(2.9) = 1.7, $p = 0.19$]. A similar pattern was seen for the Anxious/Depressed scale between the parent-rated CBCL and the child-rated YSR. The T scores were −2.4 points between pre-treatment and post-treatment for the parent ratings [95% CI: −4.6, −0.1; t(3.4) = −2.0, $p = 0.12$] and 0.2 points for the child-rated YSR [95% CI: −3.0, 3.3; t(2.5) = 0.1, $p = 0.9$].

4.3 Acceptability and feasibility

Results indicated that parents were satisfied with the experience of ACT-PAC as reported on the Client Satisfaction Questionnaire [CSQ-8 (40)], $M = 25.39$, $SD = 4.76$ (scores range from 16 to 32). The group intervention was shown to be feasible for parents to attend. Parents attended 5 of 6 weekly sessions on average, and 91% of parents attended 4 or more sessions (see Figure 4).

5 Discussion

Overall, the results suggest that the ACT-PAC group may be acceptable and feasible and thus appropriate for large-scale evaluation, implementation, and dissemination. Results indicated that the intervention may successfully decrease parent's cognitive fusion, allowing them to approach their thoughts about their child's anxiety disorder with greater psychological flexibility. Such findings replicate recently published pilot work showing that

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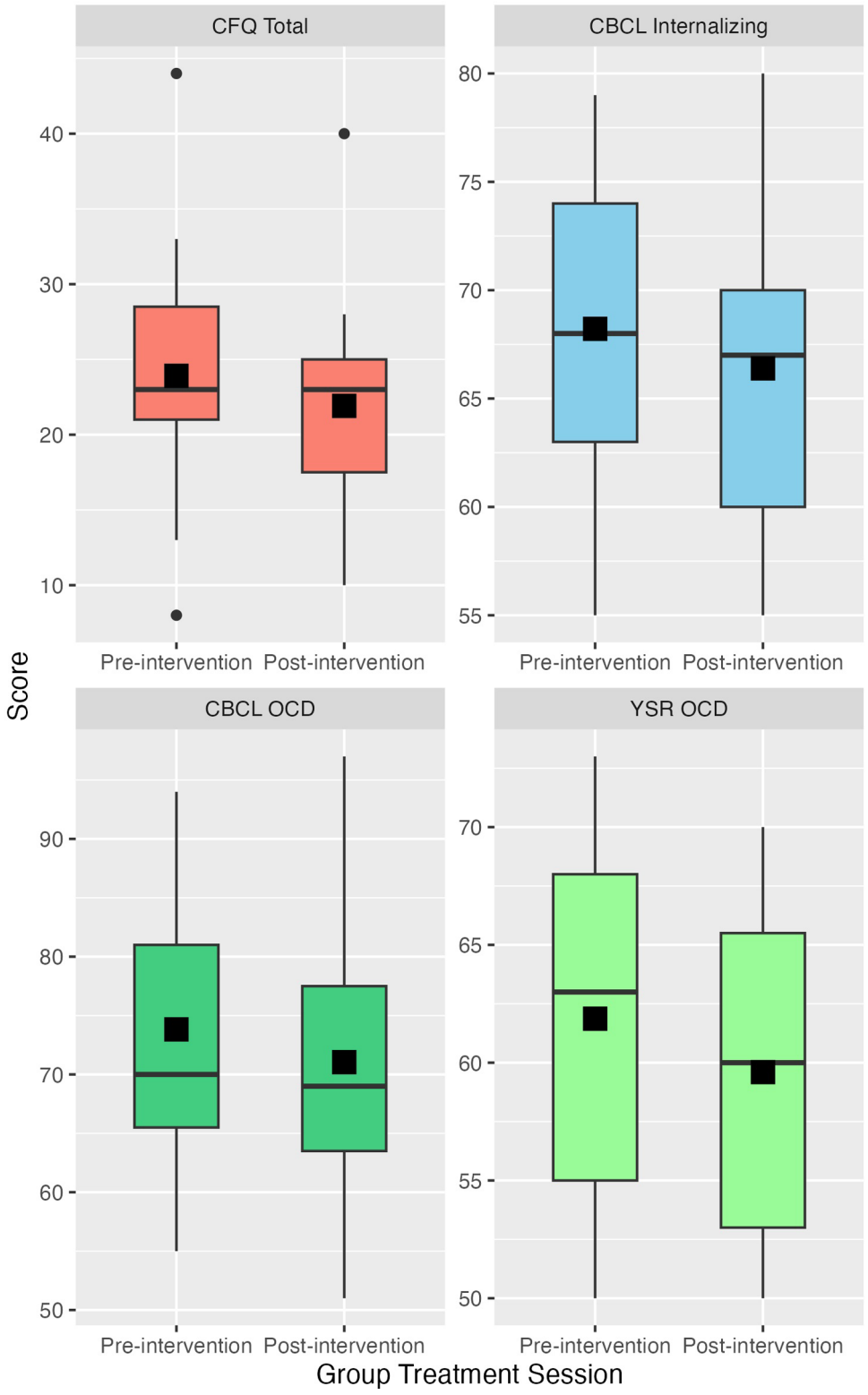

FIGURE 1
Change between pre-intervention and post-intervention for cognitive fusion, CBCL internalizing, CBCL obsessive compulsive disorder, and YSR obsessive compulsive disorder. Height of the box represents the interquartile range; median and mean are represented by the horizontal bar and filled square within each box, respectively.

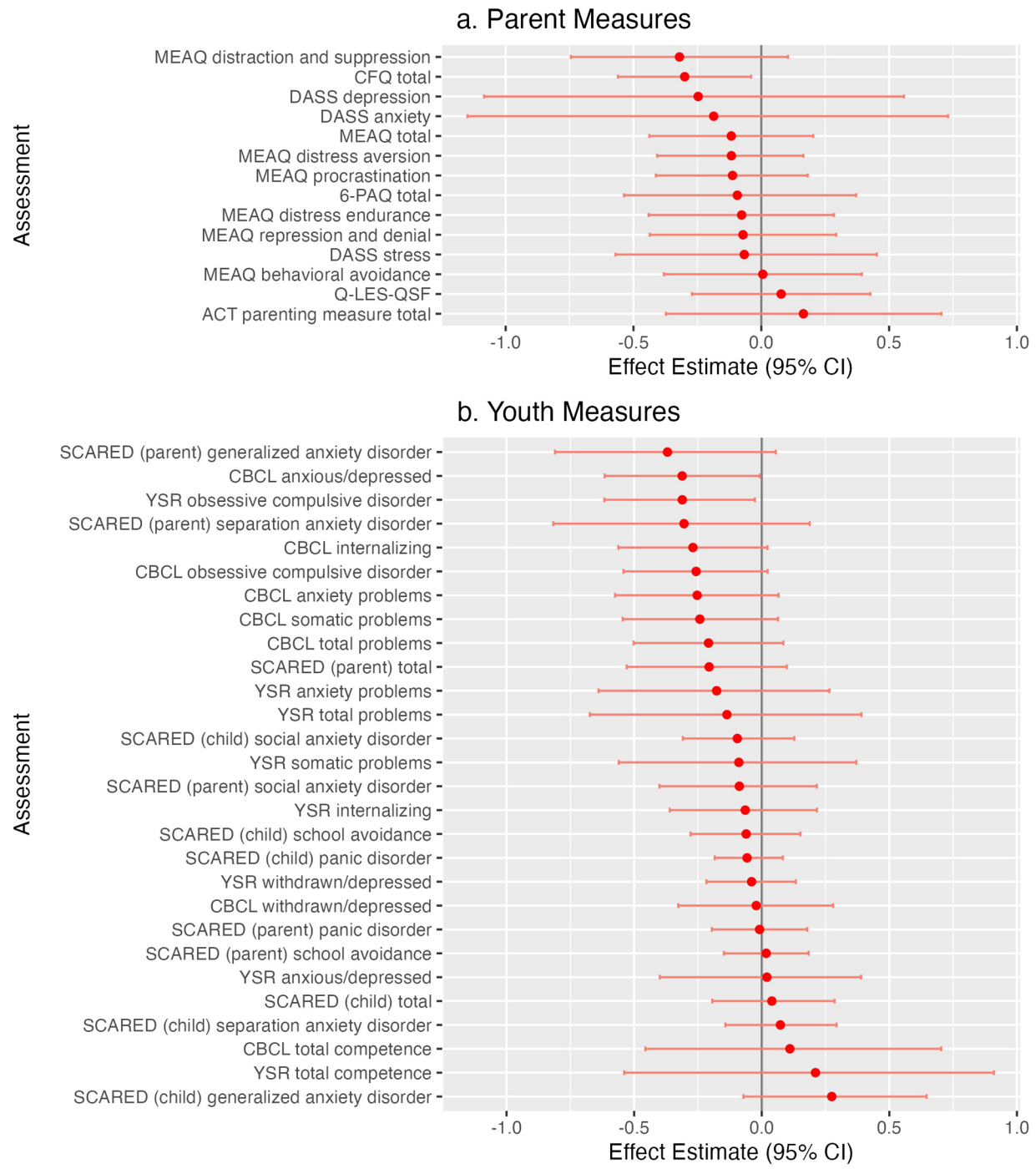

FIGURE 2
(A) Standardized effect estimates (child measures, sorted). (B) Standardized effect estimates (Parent Measures, sorted).

cognitive fusion decreased following ten group sessions of Acceptance and Commitment Therapy as parent counseling for parents of children with a variety of psychiatric problems (49). These findings are also consistent with work by Blackledge and Hayes (30) showing that a 2-day group ACT workshop with parents of autistic children produced reduced cognitive fusion that later played a role in decreasing parental depression. There are important clinical implications to this work. When parents are less fused to their own thoughts about their child's anxiety, they may be more supportive during their child's treatment by encouraging exposure to anxiety-provoking situations rather than avoidance, or providing less reassurance when their child is struggling. Results also suggested, although these findings were marginal, that the intervention may successfully reduce children's internalizing (anxiety and depression) and obsessive-compulsive disorder symptoms, at least as perceived by parents, by virtue of parents learning to think about and

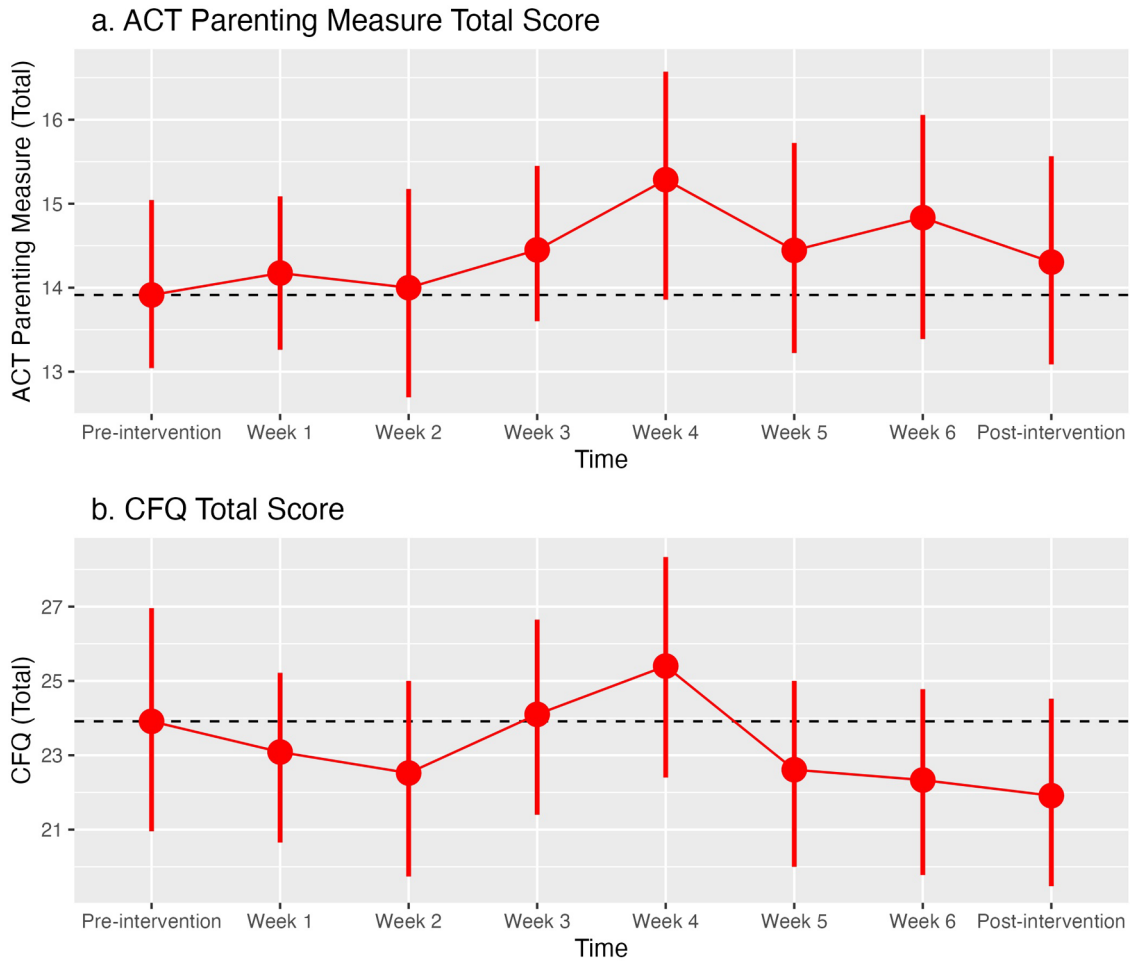

FIGURE 3
Average scores for measures obtained at each treatment session: **(A)** Acceptance and Commitment Therapy (ACT) Parenting Measure total score; **(B)** Cognitive Fusion Questionnaire (CFQ) total score. Error bars represent 95% confidence intervals.

TABLE 3A Change between Pre-intervention and post-intervention for measures of parent functioning.

Parent symptoms measures	*n*	Pre-intervention		Post-intervention		Model estimates[a]				
		M	SD	M	SD	Estimate	(95% CI)	T	P	Effect size
DASS depression	23	4.4	4.7	3.7	4.6	−1	(−3.9, 1.9)	−0.7	0.55	−0.14
DASS anxiety	23	2.5	2.6	2.2	2.9	−0.3	(−2.0, 1.3)	−0.4	0.69	−0.09
DASS stress	23	10.7	6.2	10.3	7.5	−0.4	(−3.7, 2.9)	−0.2	0.83	−0.05
Q-LES-QSF	23	0.7	0.2	0.7	0.1	0	(−0.0, 0.1)	0.4	0.66	0.09
MEAQ behavioral avoidance	23	32.2	7.3	32.2	8.5	0	(−2.7, 2.8)	0	0.98	0.01
MEAQ distress aversion	23	42.3	8.8	41.2	10.8	−1.1	(−3.5, 1.3)	−0.9	0.44	−0.19
MEAQ procrastination	23	22.8	6.6	22	7.3	−0.7	(−2.6, 1.2)	−0.8	0.45	−0.16
MEAQ distraction and suppression	23	26.5	4.8	25	5.8	−1.5	(−3.5, 0.5)	−1.5	0.15	−0.31
MEAQ repression and denial	23	27.9	7.5	27.3	9.6	−0.6	(−3.4, 2.3)	−0.4	0.7	−0.08
MEAQ distress endurance	23	48	5.2	47.6	7	−0.4	(−2.4, 1.6)	−0.4	0.67	−0.09
MEAQ total	23	180.7	26.5	177.2	35.6	−3.4	(−12.6, 5.8)	−0.7	0.47	−0.15
CFQ total	23	23.9	7.6	21.9	6.4	−2	(−3.7, −0.3)	−2.3	0.03	−0.49
6-PAQ total	23	42.3	3.9	42	3.1	−0.3	(−1.6, 1.0)	−0.5	0.67	−0.1
ACT parenting measure total	23	13.9	2.6	14.3	3.1	0.4	(−0.9, 1.6)	0.6	0.55	0.13

[a]Fixed effect estimates from model incorporating the random nested effect of treatment cohort.

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TABLE 3B Change between pre-intervention and post-intervention for measures of youth functioning.

Child symptoms measures	*n*	Pre-Intervention		Post-Intervention		Model Estimates†				
		M	SD	M	SD	Estimate	(95% CI)	T	P	Effect Size
CBCL total competence	22	44	9.9	44.6	8.9	1	(−3.5, 5.5)	0.4	0.71	0.09
CBCL internalizing	23	68.2	6.8	66.4	7.6	−1.8	(−3.8, 0.1)	−1.8	0.08	−0.38
CBCL anxious/depressed	23	69.5	8.1	67.2	8	−2.4	(−4.6, −0.1)	−2	0.12	−0.43
CBCL withdrawn/depressed	23	62.7	9.9	62.5	11.5	−0.2	(−3.2, 2.8)	−0.1	0.89	−0.03
CBCL somatic problems	23	63.8	10.4	61.6	8.5	−2.2	(−4.8, 0.4)	−1.7	0.11	−0.34
CBCL total problems	23	62.8	6.4	61.5	6.4	−1.3	(−3.0, 0.5)	−1.4	0.17	−0.3
CBCL anxiety problems	23	69.7	5.7	68.1	7.7	−1.6	(−3.6, 0.4)	−1.6	0.13	−0.33
CBCL obsessive compulsive disorder	23	73.8	11.5	71	11.3	−2.8	(−5.7, 0.2)	−1.8	0.08	−0.38
YSR total competence	15	46.9	9.4	48.5	7.8	1.5	(−3.2, 6.3)	0.6	0.56	0.16
YSR internalizing	15	19.4	11.2	18.9	11.4	−0.7	(−3.6, 2.1)	−0.5	0.66	−0.13
YSR anxious/depressed	15	62.3	10.2	62.6	8.9	0.2	(−3.0, 3.3)	0.1	0.92	0.03
YSR withdrawn/depressed	15	59.7	9.7	59.3	10.7	−0.4	(−2.1, 1.3)	−0.5	0.65	−0.12
YSR somatic problems	15	57.2	7.1	56.6	9.7	−0.7	(−4.1, 2.6)	−0.4	0.7	−0.11
YSR total problems	15	55.9	7.9	55	9.5	−1.1	(−5.1, 2.8)	−0.6	0.61	−0.15
YSR anxiety problems	15	64.3	8.3	63.1	7.8	−1.4	(−4.4, 1.7)	−0.9	0.45	−0.22
YSR obsessive compulsive disorder	15	61.9	7.8	59.6	7.2	−2.3	(−4.2, −0.4)	−2.3	0.1	−0.61
SCARED (child) total	23	28.4	17.6	28.9	17.9	0.7	(−3.0, 4.4)	0.4	0.74	0.08
SCARED (child) panic disorder	23	6.4	6.7	6	7	−0.4	(−1.2, 0.4)	−1	0.41	−0.2
SCARED (child) generalized anxiety disorder	23	8	4.9	9.2	4.8	1.3	(−0.2, 2.8)	1.7	0.19	0.35
SCARED (child) separation anxiety disorder	23	3.7	3.6	3.9	3.7	0.3	(−0.5, 1.0)	0.7	0.5	0.14
SCARED (child) social anxiety disorder	23	7.9	5.3	7.4	5	−0.5	(−1.5, 0.5)	−0.9	0.37	−0.19
SCARED (child) school avoidance	23	2.5	1.9	2.4	2.3	−0.1	(−0.6, 0.3)	−0.5	0.63	−0.11
SCARED (parent) total	23	29.6	15.3	26.6	16.4	−3.1	(−7.4, 1.1)	−1.4	0.25	−0.3
SCARED (parent) panic disorder	23	5.2	4.9	5.2	5.6	0	(−1.0, 0.9)	−0.1	0.93	−0.02
SCARED (parent) generalized anxiety disorder	23	10	5.1	8.4	4.5	−1.7	(−3.5, 0.1)	−1.9	0.16	−0.39
SCARED (parent) separation anxiety disorder	23	4.2	4.4	3.2	3.3	−1.1	(−2.7, 0.5)	−1.3	0.28	−0.28
SCARED (parent) social anxiety disorder	23	7.7	4.9	7.3	5.2	−0.4	(−1.8, 0.9)	−0.6	0.58	−0.13
SCARED (parent) school avoidance	23	2.5	2.5	2.5	2.6	0	(−0.4, 0.4)	0.2	0.83	0.04

†Fixed effect estimates from model incorporating the random nested effect of treatment cohort.

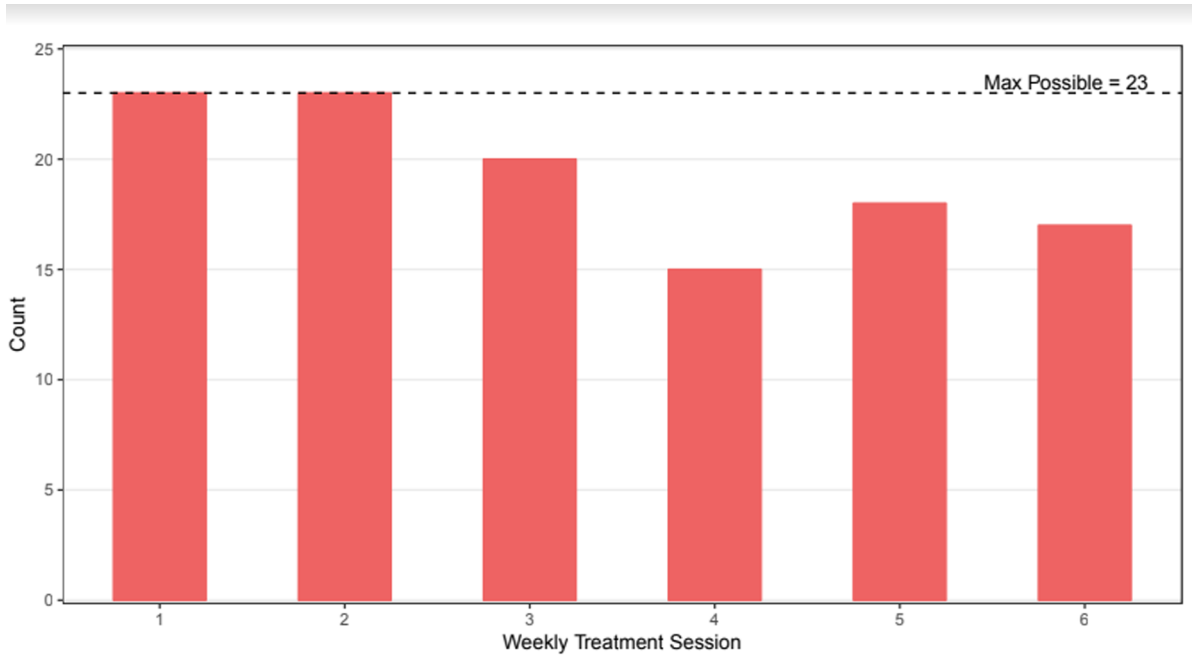

FIGURE 4
Parent attendance at weekly sessions.

respond to their child's anxiety in new ways. This work extends a growing body literature that has found that an ACT intervention designed for parents produces favorable outcomes in children [e.g., (21, 29)]. Interestingly, unlike other ACT interventions for parents [e.g., (30)] the intervention did not produce a reduction in experiential avoidance. Unlike for cognitive fusion, it may be particularly difficult for parents to remain in contact with distressing feelings, thoughts, memories or other private experiences in the absence of between-session support for moments in which they are acutely stressed, and may be most likely to fall back on patterns of avoidance. In addition, there were no changes in parental quality of life or clinical outcomes, though it is worth noting that most of the participants in the study were not highly distressed according to our measures of depression, stress and anxiety. Although some research on other parent populations [e.g., parents of children diagnosed with autism; (30)] has shown that Acceptance and Commitment Therapy can improve psychological outcomes, others have found improvements in ACT processes (e.g., mindfulness, acceptance, valued living and cognitive defusion) but not parent stress, anxiety and depression (50). Such findings may suggest that parents' ability to work with symptoms improve over treatment, and that even if symptoms are present, they may be less disruptive. This is clinically relevant as parents caring for a child with anxiety may themselves experience stress, anxiety or depression and so equipping parents with the skills to live with these experiences may be more significant than eradicating the symptoms altogether.

5.1 Limitations and future directions

There were several noteworthy limitations to this study. First, is the homogenous sample, which was not representative of the general population of parents of anxious children, in that it was white and highly educated. Further, our recruitment through a Pediatric OCD and Anxiety Disorders Clinic raises the possibility that patients in the sample had high treatment access, further limiting the generalizability of our study findings. It remains to be studied whether ACT-PAC would be acceptable to parents of different cultural groups or whether the effects of the group may differ among a diverse set of families, in terms of race/ethnicity, socioeconomic status, and presenting problems. Replication with other samples is a necessary next step.

Second, although client satisfaction surveys and high attendance rates point to an intervention that is both feasible to implement and acceptable to clients, future research, that may take the form of a focus group with participating families, should obtain additional parent feedback on the intervention and on study protocols. In particular, given that the intervention was delivered as a weekly group, without between-session support to help parents implement recommended changes in moments when they are acutely stressed, it would be important to assess whether participants had trouble remembering to use the techniques during times of acute distress. Newly developed technology (e.g., wearable biosensors) can alert parents when their physiological stress levels are rising and provide immediate reminders (via smartphone) to use the newly learned techniques in these moments of stress when the techniques might be most needed. Future research may explore with parents how this mobile technology might further support the usefulness of ACT-PAC.

Third, for the vast majority of our measures, our data only had two timepoints (pre/post). As a result, we were limited to only providing information about change, and could not assess additional information about the shape of change (e.g., linear, non-linear) or the timing of change. Further, in the absence of a comparison group (e.g., waitlist control or psychoeducational control group), we cannot draw any conclusions about the "active ingredient" driving intervention effects. It is entirely possible that the preliminary effects demonstrated in this study were due to the social support received from the interventions' group setting or merely just the passage of time. A more rigorous study design in the form of a randomized clinical trial is necessary to better understand the mechanism of change to to explicitly determine whether the effects are due to non-specific factors (e.g., group support, opportunities for self-disclosure) or specific ACT content (e.g., mindfulness, cognitive defusion). Fourth, this study does not provide information about change in targeted parenting behaviors (e.g., autonomy support) through treatment. While our study included both child clinical outcomes and ACT-related measures, we did not measure whether the intervention changed parenting behaviors. Future research should systematically evaluate change in parent behavior during parent-child interactions as a result of this intervention and address the mechanisms through which ACT-PAC may be exerting its influence [e.g., by enhancing psychological flexibility and acceptance (22);]. Future research should also consider including multi-informant clinical outcomes, especially in light of the current findings showing increases in child-reported generalized anxiety disorder symptoms but decreases in the same symptoms when parents were the informant (although neither increase nor decrease reached statistical significance). This intervention may produce particularly salient effects for parent reported clinical outcomes, as the intervention may impact the lens through which parents are viewing their child.

In summary, in light of research highlighting that up to 40% of youth don't meaningfully benefit from treatment (8), this study suggests that ACT-PAC may uniquely address parent-child processes that may be impeding treatment progress. Results suggest that ACT may benefit anxiety affected families, improving both parents and children, and help families effectively engage in valued pursuits.

Data availability statement

The datasets presented in this article are not readily available because HIPPA. Requests to access the datasets should be directed to jrafteryhelmer@worcester.edu.

Ethics statement

The studies involving humans were approved by University of Massachusetts Chan Medical School. The studies were conducted

in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

JR-H: Writing – original draft, Project administration, Methodology, Investigation, Conceptualization. AH: Writing – review & editing, Project administration, Methodology, Investigation. ML: Writing – review & editing, Investigation. SH: Writing – original draft, Formal Analysis. LC: Writing – review & editing, Resources. PM: Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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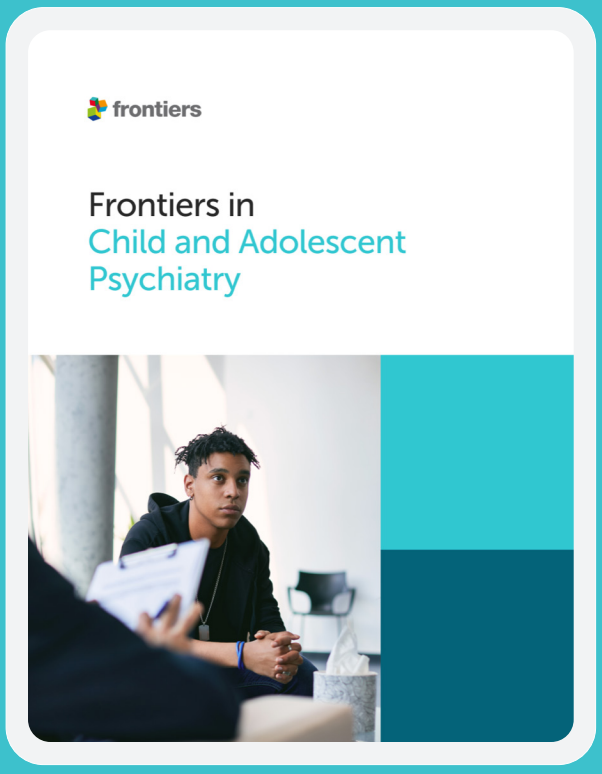

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