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Virtual delivery of group-based cognitive behavioral therapy for autistic children and youth during the COVID-19 pandemic was acceptable, feasible, and effective

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Anxiety challenges co-occur at a high rate in autistic children and youth (~ 50–79%), often with significant interference with daily functioning. Evidence-based interventions (e.g., cognitive behavioral therapy (CBT)-based approaches) are effective in treating anxiety disorders across populations. Facing your fears (FYF), a group-based CBT program modified for youth with ASD, yields positive outcomes in controlled research settings and community implementation, but access is constrained by limited system capacity and families' distance from specialized centers. COVID-19 spurred innovations in virtual delivery of care, generating possibilities for increased scalability of evidence-based treatments. This study investigated the feasibility, acceptability, and effectiveness of FYF when delivered virtually through a tertiary care hospital in Ontario. Data were collected over one year (N = 100 autistic children/youth aged 8–13 years and their caregivers). Significant improvements emerged in caregiver- and self-reported anxiety symptoms, and caregivers reported increased self-efficacy in supporting their child with their anxiety. Significant predictors of treatment response included youth baseline anxiety, level of adaptive functioning, ASD symptoms, and caregiver self-efficacy. Three COVID-related factors were small but significant contributors to the model. Virtual delivery of FYF is feasible and effective for treating elevated anxiety in autistic children/youth and may improve access.

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Autism spectrum disorder (ASD/autism) is a neurodevelopmental condition characterized by impairments in social interaction and communication, and the presence of stereotyped, repetitive behavior and/or restricted interests[1], with prevalence rates of approximately 1 to 1.5% in Canada[2] and globally[3]. Anxiety symptoms and disorders are common in autistic children and youth[4], with rates of co-occurrence ranging from 50% to almost 80%[5–7]. Anxiety symptoms can cause considerable distress and interfere with daily individual and family functioning[8], and without effective intervention, the impacts of anxiety can lead to negative long-term mental

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health outcomes[9]. As such, enabling access to anxiety treatment is of paramount importance to autistic youth who experience significant anxiety symptoms.

Cognitive behavioral therapy (CBT) is a well-established treatment for anxiety in children and youth[10], with positive outcomes in response to approaches designed specifically for autistic populations[11–17]. Systematic reviews and meta-analyses[18,19] demonstrate the efficacy of psychosocial interventions for managing anxiety in autistic youth, in the context of well-controlled research designs.

One such intervention, *Facing Your Fears (hereafter FYF)*[20], is a CBT-based program specifically adapted for autistic children and youth. The FYF program is a 14-week group CBT program for children with autism ages 8–14. Children/youth and their parents participate in the program together, which involves large-group instruction as well as separate parent and child groups. The sessions focus on identifying emotions and worries, developing coping strategies (e.g., deep breathing, helpful thoughts), and "facing your fears" with support from facilitators. Modifications and adaptations that make the program more accessible to children with ASD include the use of visual schedules, visual aides, predictability in routine, hands-on activities, multiple opportunities for repetition and practice, and taking a strengths-based approach. The program has demonstrated group-level reductions in anxiety through a pilot study and subsequent randomized control trial (RCT)[12,13]. Recent findings from a large Canadian sample strengthen the evidence for the effectiveness of the program when delivered via community implementation[21]. Although of considerable interest, efforts to identify individual differences in treatment response have yielded inconsistent information about predictors across child- (e.g., cognitive ability, autism symptoms) and family-level, as well as complex interactional factors[21].

The COVID-19 pandemic and associated isolation measures spurred innovations in service delivery approaches including a rapid increase in, and innovations relating to, virtual care for general psychotherapy[22]. Parents of children with neurodevelopmental disorders have identified virtual (i.e., telehealth) services as a priority area, with a particular call for services that provide an interactive one-to-one component[23]. The promise of virtual care in autism has recently been demonstrated in the spheres of early intervention[24,25], behavior management[26], and social skills development[27–29]. Virtual delivery of an evidence-based anxiety management curriculum in ASD (i.e., *Facing Your Fears*) has been demonstrated as an acceptable and feasible approach, with promising outcomes in a small sample (n = 17)[30].

Faced with the urgent need for innovative approaches to mental health supports for autistic children and youth, and bolstered by evidence of feasibility, acceptability, and preliminary efficacy[30] we made additional minor modifications, and delivered the adapted, group-based program virtually throughout the Canadian province of Ontario, over a one-year period. The current study examined child and parent outcomes, and predictors thereof, and explored implementation factors, aiming to answer the following questions:

1. Child anxiety outcomes—Is a virtual adaptation of the *Facing Your Fears* program effective at reducing anxiety? Informed by the extant research evidence, we predicted a significant reduction in anxiety symptoms, but we anticipated an attenuated effect given the virtual nature of the program.
2. Implementation factors—Is the *Facing Your Fears* program for autistic youth with anxiety feasible and acceptable via virtual delivery? We expected good program compliance and retention, with moderate-to-high satisfaction ratings. We also explored geographic reach, with the hypothesis that the virtual delivery format would enable participation from families living farther distances from large urban areas or treatment centers (which has been a barrier in related work).
3. Predictors—Are there any child and family characteristics, including COVID-19-related factors, that significantly predict treatment response? Based on recent findings[31,32], we predicted that COVID-related hardships would interact with response to treatment.

Method

Participants

One hundred children/youth, aged 8 to 13 years and their parents/caregivers (hereafter caregivers) participated in a 12-week CBT-based intervention adapted for individuals with ASD (*Facing Your Fears*[20]) delivered virtually through a specialized pediatric hospital setting in Ontario, Canada; see (Fig. 1). All children had a diagnosis of ASD (DSM-5-TR, or DSM-IV Autism, Asperger Syndrome, or Pervasive Developmental Disorder–Not Otherwise Specified) made by a physician or psychologist prior to enrollment, and participants were required to be aware of their diagnosis. Per Canadian clinical best practice guidelines,[33] no specific measure was required to confirm diagnosis, but families were required to provide documentation with proof of ASD diagnosis from a diagnosing clinician. Inclusion based on an existing diagnosis (vs. conducting the assessment within the study itself) enabled enrollment during COVID-19 and allowed us to reach families across Ontario, which was a major objective of this work; such families would have been missed if they had been required to complete an in-person diagnostic assessment.

Participation required elevated child/youth anxiety symptoms (determined during screening, described below), a reading/verbal ability at a grade 2 level or above (as reported by parents/participants), and willingness to join virtual group sessions. A formal diagnosis of anxiety disorder was not required for two main reasons: (i) We were interested in evaluating whether the intervention could reduce impairing symptoms *regardless of a formal anxiety disorder*; and (ii) we are aware of significant systemic barriers to accessing mental health diagnostic services for all youth (i.e., resource constraints, family distance from mental health services, long waiting lists, etc.), access to which was further limited by COVID-19 isolation measures, and which disproportionately affect autistic youth and families from rural and remote regions[34]. Requiring a formal diagnosis would have excluded these under-represented groups.

Comorbid difficulties (e.g., depressed mood, attention-deficit/hyperactivity disorder, learning disability) did not exclude youth who were considered likely to be able to manage the virtual group context. For youth

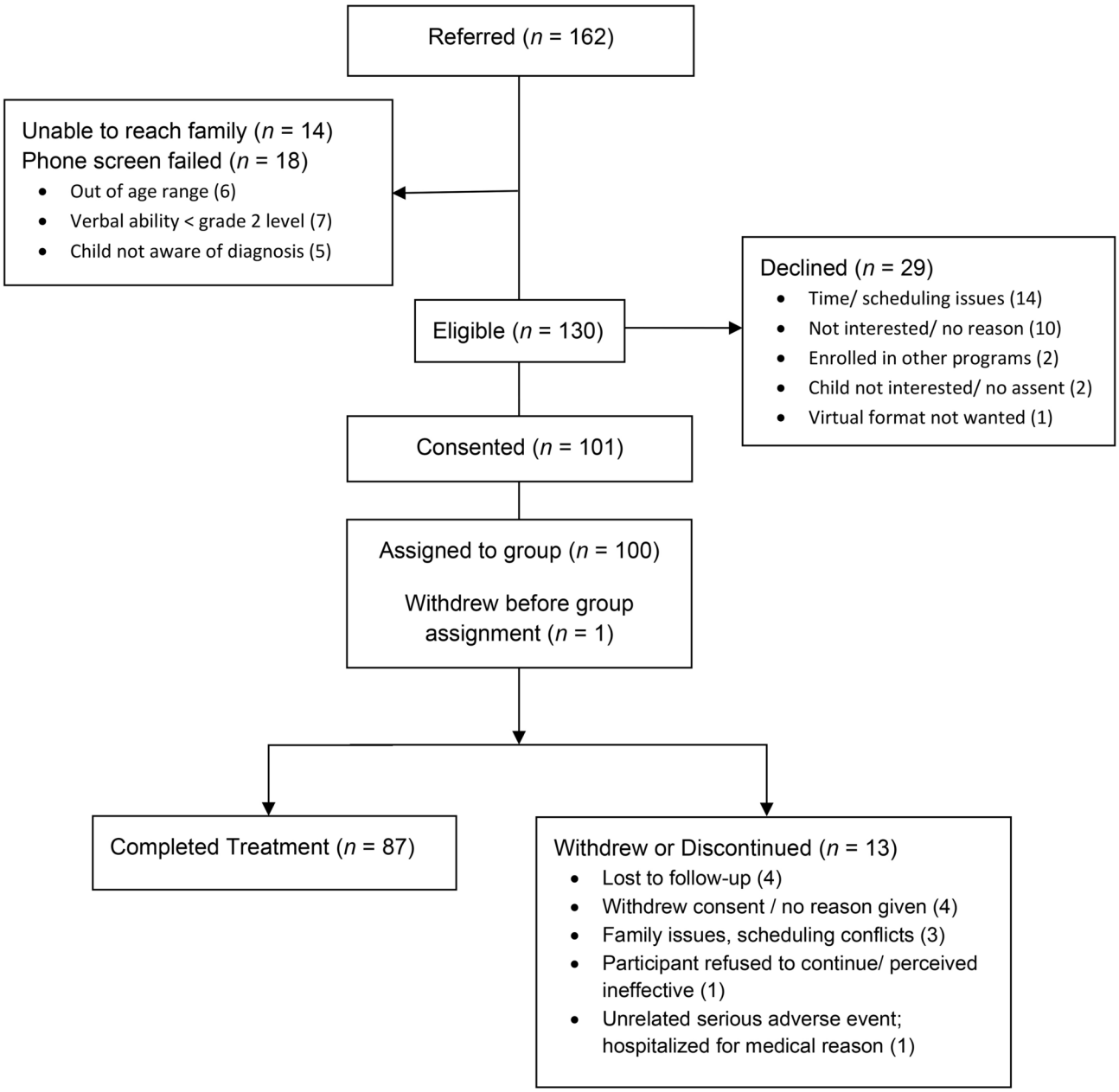

Fig. 1. CONSORT diagram of study flow.

on anxiety medications, the dose had to be stable for the month prior to group start (6 weeks for fluoxetine). Exclusions were enrollment in any concurrent non-pharmacological anxiety interventions, acute psychosis, or exclusive conduct or OCD diagnosis.

Procedure

The study received Research Ethics Board approval at Holland Bloorview Kids Rehabilitation hospital, in Toronto, Canada.

Eligibility screening and consent

The screening process involved two steps: ***Step 1*** entailed a phone call with prospective parent participants (child was not required to be present) for an initial brief eligibility screen (confirmation of child's ASD diagnosis, anxiety symptoms, and parents' perception of the child's readiness to work in a group context over Zoom), and review of consent documents with a research team member. Once all questions were answered, parents were sent a link to sign consent through an online portal. ***Step 2*** took place over Zoom for Healthcare with the parent (for comprehensive eligibility interview, described below) and the child/youth also joined for at least part of the call in order to learn about the study, ask questions and provide their assent or consent to participate, per our Ethics Board-approved process. Once consent/assent was obtained, the comprehensive eligibility interview

was conducted by a FYF facilitator, via a semi-structured interview (approx. 45 min) that elicited information about previous assessments, interventions and diagnoses, supports required for learning, prior experience in group settings/current ability to participate in groups, and detailed information about past and current mood and anxiety symptoms and management (formal diagnoses, specific fears, phobias, avoided situations, previous interventions, medications). Parents were asked to describe how much their child's anxiety is interfering in the daily functioning of the child and their family, how much the family has to modify plans because of the anxiety, how often the child appears anxious/talks about being anxious. Once a cohort was identified, the research team met together to make decisions about group composition based on factors such as age, expressive language level, potential interpersonal compatibility, and the family's scheduling needs.

The intervention

The group-based *Facing Your Fears* intervention was delivered as described in the *Facing Your Fears Facilitator's Manual*[20], with the modifications described below. Groups were run primarily by registered psychologists (both in autonomous and supervised practice) and pre-doctoral psychology interns/residents; other group leaders included one developmental pediatrician, one registered social worker and one social work master's student. The core group of psychologists were experienced in delivery of the original *Facing Your Fears* program, and received supervision from co-author (AS), the lead psychologist who was formally trained by, and met implementation fidelity criteria with, the program developer (J Reaven; JR), and had many years of clinical experience running FYF in person at a community hospital[21]. Every group had at least one facilitator who was a regulated mental health professional who had been trained by either AS or JR (program developer). Clinicians were selected either internally (based on relevant experience with autism, mental health, and/or intervention) or externally, via professional networks to ensure breadth across the province. Each prospective clinician was approached by a member of the research team to gauge their interest, experience, and availability.

Modifications for virtual delivery

We used the virtual adaptation of the *Facing Your Fears* program developed by J Reaven and her team ("Facing Your Fears: Adaptation for Telethealth"; unpublished protocol; personal communication). We made the following additional minor modifications:

- Number of sessions reduced from 14 to 12 to maximize the number of families seen in the 1-year study period (note that 2 sessions were replaced with individual caregiver phone calls for individual trouble-shooting with parent–child dyads, discussion of steps, assistance with generalization of skills, and to bolster parent confidence).
- Longer duration of segments for child/youth participation (45–60 min, vs. 25–30 min per Reaven adaptation for telehealth) within parent–child sessions.
- On 2 of the weeks: Replaced parent group component and used virtual breakout rooms for individual parent–child sessions with a facilitator. This replaced the in-vivo coaching done in the in-person groups.
- All other modifications were minor (e.g., leaving out minor activities or completing activities as a group instead of as individual dyads—these minor adjustments were made to increase efficiency for the virtual model and to maintain participants' interest and attention during the virtual sessions (i.e., to mitigate Zoom fatigue).
- The clinicians sought and received the endorsement of *Facing Your Fears* developer throughout the current project.

Four 12-week cycles, each composed of 4–6 groups, were delivered from January – December 2021, for a total of 20 groups. Each group consisted of 4–6 parent–child dyads (or caregiver-child dyads if primary caregiver was not the child's parent) and entailed 12 weekly 1.5 h sessions and two telephone sessions with the parent/caregiver. As described in previous work[21], and per the *Facing Your Fears* Facilitator's Manual[20], group sessions focused on emotion identification and regulation, practicing relaxation and using 'helpful thoughts', as well as exposure practice (i.e., gradually facing one's fears). Each weekly session included a parent–child portion, where all parents and children were present online together. Ten of the 12 sessions also included a parent-only portion following the parent–child groups, while the other two sessions involved breakout rooms that allowed each parent–child dyad to meet individually with a facilitator. Weekly home practice was assigned, and reinforcement strategies were used to encourage and motivate exposure practice between sessions.

Measures

All measures were completed virtually, via access links sent to the families. Participants responded directly via data collection forms created in REDCap, a secure, web-based application which also housed the database. Relevant licensing permissions were obtained.

Adaptive behavior assessment system-second edition, parent form (ABAS–II, Ages 5–21)[35]

The ABAS-II is a norm-referenced questionnaire assessing adaptive skills. The parent form (for children aged 5 to 21) was used at baseline as a descriptive measure of the child's overall adaptive functioning. The ABAS-II consists of an overall General Adaptive Composite (GAC) and three core domains: Conceptual (including communication, functional academics, and self-direction), Social (which includes leisure and social functioning), and Practical (entailing community use, home living, health and safety, and self-care); the Conceptual and Social domains make up an "Adaptive" domain. GAC has good internal consistency ($\alpha = 0.97$ to 0.99), test–retest reliability ($r = 0.90$s), and inter-rater reliability ($r = 0.82$ to 0.91 across paired adult respondents). Good internal consistency has been shown across the adaptive domains and the ten skill areas ($\alpha = 0.91$ to 0.98, and 0.80 to 0.97,

respectively); as well as solid test–retest reliability ($r = 0.80$s to 0.90s; 0.70s to 0.90s, respectively), and inter-rater reliability ($r = 0.78$ to 0.84; 0.70 to 0.82, respectively)[35].

Social communication questionnaire (SCQ), lifetime version[36]
The SCQ is a 40-item (Yes/No) parent-completed questionnaire. The SCQ has high internal consistency ($\alpha = 0.84$ to 0.93) and good sensitivity (0.71) and specificity (0.71) in distinguishing between ASD versus non-spectrum diagnoses, based on a cut-off score of 15; a cut-off of 12 yields higher sensitivity (0.82), but lower specificity (0.56). Subscale scores can be calculated for Reciprocal Social Interaction, Communication, and Restricted, Repetitive, Stereotyped Patterns of Behavior, but with limited information about their reliability. We used the total score at baseline to characterize child/youth autism characteristics.

Screen for child anxiety related emotional disorders, parent and child versions (SCARED)[37]
The SCARED is a 38-item measure of anxious symptoms, available in parent-rated and self-rated versions. Responses on the SCARED yield a total score (≥ 25 being indicative of the presence of an anxiety disorder) as well as domain scores for generalized anxiety, separation anxiety, social anxiety, panic or somatic symptoms, and school avoidance.

Good psychometric properties are reported, in the standardization sample of outpatient children and adolescents, for the total score and all five factors on the parent and child versions (internal consistency: $\alpha = 0.74$ to 0.93; test–retest reliability: ICC = 0.70 to 0.90) and good discriminant validity[37], and has been validated for use with children with ASD[38]. We used both the parent- and child- (self-) report versions at both time points to measure changes in anxiety symptoms. Although there was moderate, but significant parent–child agreement in the standardization sample ($r = 0.20$ to 0.47)[37], more recent evidence of weaker (though significant) informant agreement between parents and youth (total and subscale scores ICCs = 0.14–0.19) has been identified[39], highlighting the importance of collecting information from both sources whenever possible.

Anxiety impact questionnaire, parent and child versions
This questionnaire, developed for a related study (previously referred to as "group questionnaire"[21]), was completed at baseline and post intervention. It entails quantitative ratings on a Likert-type scale from 0 (not at all) to 8 (very, very much) about the child's anxiety severity level ("worry"), its interference with daily life, and management strategies currently being used, as well as an open-ended section to share any other relevant information. The parent version asks how *effective* and how *confident* the parent feels about helping their child manage their anxiety (these two ratings were combined for an index of caregiver self-efficacy). Although this questionnaire has been used in previous work[21] it has not been validated; as such, no psychometric data are available.

Satisfaction questionnaire
Parents' satisfaction with the program was measured following intervention. The satisfaction questionnaire was adapted from related work[21] for the current study. It includes 14 items (e.g., quality of the program, amount and type of help received, value of group sessions, quality of instruction, acceptability of virtual format, etc.) each rated on a scale from 1 (least) to 9 (most satisfied/helpful). Parents were also invited to report what they liked most and least about the program, as well as any other comments, in an open-ended section at the end of the questionnaire. This questionnaire was adapted from previous work[21] but has not been validated; as such, no psychometric data are available.

CoRonavIruS health impact survey–adapted for autism and related neurodevelopmental conditions (CRISIS-AFAR)—V0.5.1 (parent/caregiver baseline form) & V0.6.1 (parent/ caregiver follow up form)[40]
The **CRISIS-AFAR** survey aims to assess the specific needs and changes related to the Coronavirus/COVID-19 crisis in individuals with ASD and related neurodevelopmental conditions across the lifespan. The CRISIS-AFAR maintains the general structure of the core CRISIS from which it was adapted, including basic demographic information and questions that make up four domains: (1) Covid Health Exposure/Status, (2) Life Changes (e.g., food insecurity, financial difficulty, positive changes), (3) COVID-19 Worries (e.g., physical, mental worries), and (4) Behaviour/Media impacts (e.g., sleep disruption, TV/ video gaming activities). The CRISIS-AFAR adds to these an array of items across four additional domains: (1) Adaptive Living Skills, (2) Restricted/ Repetitive Behaviours, (3) Co-occurring 'problem' Behaviour, and (4) Service Access (i.e., services that were lost or continued within and outside of the school setting)[40].

Analytic approach

Primary outcome
For the primary analysis only, we used an intent-to-treat approach, wherein missing post-intervention data were replaced using the imputed linear regression value (thus $n = 100$). Parent-reported child anxiety symptoms (SCARED-Parent; hereafter SCARED-P) was compared (pre- vs. post-intervention) using a paired-samples t-test with Bonferroni correction (0.05/6; thus critical $p < 0.0082$) to account for multiple tests using the six subscales on the SCARED-P. We also explored the proportion of participants whose Anxiety Total scores exceeded the clinical cut-off (i.e., ≥ 25) on this measure, using χ^2 to examine pre-post differences.

Secondary outcome
Change in child-reported anxiety symptoms (SCARED-Child; hereafter SCARED-C) was examined using paired-samples t-tests (corrected critical $p = 0.0082$), and χ^2 for the proportion of children whose Anxiety Total score exceeded the clinical cut-off.

Implementation factors
We examined parent satisfaction and self-efficacy as indices of acceptability and explored other implementation factors such as feasibility (i.e., program compliance, retention), geographic reach, and socio-demographic diversity.

Predictors of response
Preliminary analyses were conducted to identify single predictors using individual linear regressions. Next, a hierarchical regression examined the influence of 11 variables (demographic factors, baseline child characteristics, and any of the variables that were identified as single predictors) in the model. We used Bonferroni correction to account for multiple variables in the model (critical $p = 0.05/11 = 0.0045$).

Results

Sample description

Group facilitators
Group facilitators included registered psychologists ($n = 11$; in autonomous or supervised practice), pre-doctoral psychology interns ($n = 2$), one developmental pediatrician, one registered social worker, and one social work master's student. One facilitator was male, all others were female; all had prior clinical experience working with autistic children and youth. The study's lead clinician (AS) was trained by, and met fidelity with, the *Facing Your Fears* program developers.

Participants
One hundred families enrolled in the study, with 87 completing both pre- and post-program data elements (hereafter 'completers'). Recruitment took place through the lead study hospital, via advertisements posted by the provincial autism advocacy organization (Autism Ontario) and via clinical networks of community professionals. Participating children/youth were aged 8 to 13 years ($M = 10.54$, $SD = 1.50$), with 78.8% identifying as male. The majority of participating caregivers were mothers (90.9%). See Fig. 1 for CONSORT diagram and Table 1 for sample characteristics.

Primary outcome - treatment effects (parent-report)

Paired samples t-tests revealed significant improvements (pre- vs post-intervention) on the SCARED-P, for both Total Anxiety ($M = 34.91$, $SD = 13.00$, vs $M = 27.90$, $SD = 11.85$), $t = 3.99$, $p < 0.001$; Cohen's $d = 0.56$) and Generalized Anxiety ($M = 10.70$, $SD = 4.21$, vs $M = 8.88$, $SD = 3.87$), $t = 3.18$, $p = 0.008$; Cohen's $d = 0.45$). Moreover, the proportion of children meeting the clinical cut-off for Total Anxiety (i.e., a score of ≥ 25) decreased significantly from 76% to 57% ($\chi^2 = 7.27$, $p = 0.007$, cramer's $V = 0.19$).

Secondary outcome - treatment effects (child/youth self-report)

Paired samples t-tests revealed significant improvements from pre- to post-treatment on the self-reported SCARED-C, only for Anxiety Total ($n = 97$; $M = 34.52$, $SD = 12.48$, vs $M = 28.85$, $SD = 13.16$), $t = 3.08$, $p = 0.002$; Cohen's $d = 0.44$). The proportion of children/youth meeting clinical cut-offs for anxiety decreased significantly from 82.5% to 60.8% ($\chi^2 = 10.15$, $p = 0.001$, $V = 0.23$).

Implementation factors

Acceptability–parent satisfaction
Parents reported high overall satisfaction with the program averaged across satisfaction items ($n = 87$, $M = 7.95$, $SD = 1.03$). We were particularly interested in the Satisfaction item related to the virtual delivery format, "*Were you satisfied receiving this intervention virtually (as opposed to an in-person program)*?" (1- no, definitely not; to 9–yes, definitely), given that this was the primary adaptation and purpose of the current study, which received a mean score of 7.60/9 (SD = 1.71).

Feasibility–retention and program compliance
Of the families that enrolled in the study, 87% provided post-intervention data. Our measure of program compliance revealed that 83% of families attended at least nine of the 12 sessions (i.e., 75% of the program; missing no more than 3 sessions). To explore the impact of treatment compliance on the effectiveness of virtual *Facing Your Fears*, we grouped the number of sessions into categories (< 7, 8–9, 10–11, 12). ANOVA revealed no association between attendance and treatment response based on SCARED-P, $F(3,96) = 0.29$, $p = 0.83$.

Geographic reach
At the time of study launch, the province of Ontario (Ministry of Health) supported a network of 14 regional health authorities responsible for public health care services across the province. These Local Health Integration Networks (LHINs; renamed Home and Community Care Support Services in April 2021) were designed to ensure province-wide coverage of care. Participants in the current study represented 13 of the province's 14 LHINs, with participant representation missing from the North-West region (see Fig. 2). Due to the virtual nature of the program, we were also able to recruit group facilitators from across the province, with one joining from the North-West LHIN, > 1700 kms from the central hospital in Toronto.

Predictors of treatment response–I. preliminary investigation of single predictors

Sex of participating child/youth
ANOVA (with 3 groups: male, female, non-binary) was significant, $F(2,96) = 3.56$, $p = 0.03$, but none of the post-hoc analyses survived error correction. Due to small sub-sample identifying as non-binary, we re-ran the

Variable	N (% of available data)	Mean ± SD
Sex of child	Male: 78 (78.8%)	–
	Female: 18 (18.2%)	
	Non-binary: 3 (3.0%)	
	Missing: 1	
Age of child	8 years: 8 (8.1%)	10.54 ± 1.50
	9 years: 19 (19.2%)	
	10 years: 25 (25.2%)	
	11 years: 18 (18.2%)	
	12 years: 16 (19.2%)	
	13 years: 13 (13.1%)	
Ethnicity	Asian: 7 (7.5%)	
	Black: 4 (5.4%)	
	Caucasian: 73 (78.5%)	
	Other: 9 (9.7%)	
	Missing or not disclosed: 7	
ABAS-II GAC	99	66.12 ± 12.16 (range: 41—111)
		Note: $n = 66$ with GAC < 70
SCQ total	100	18.54 ± 7.17 (range: 2 – 35
SCARED-parent	100	34.91 ± 13.00
Total anxiety		
Parenting role	Mother: 90 (90.1%)	–
	Father: 8 (8.1%)	
	Other: 1	
Parent educational attainment (primary caregiver)	Graduate/professional Degree: 34 (34.7%)	
	4-year college/ University graduate: 29 (29.6%)	
	Some college/2-year Degree: 29 (29.6%)	
	High school or less: 6 (6.1%)	
	Missing: 2	

Table 1. Participant baseline characteristics.

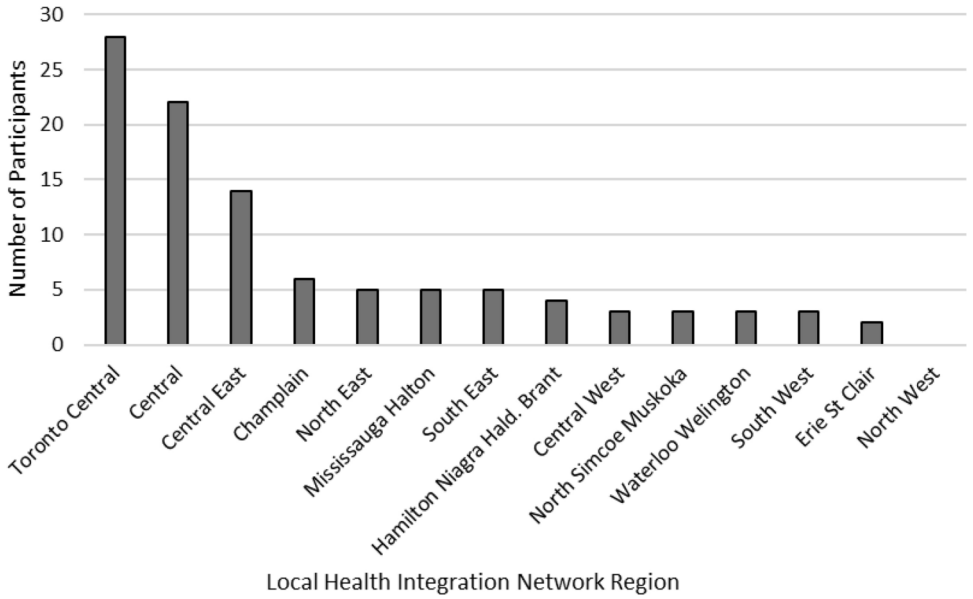

Fig. 2. Local health integration network regions represented by study participants.

ANOVA with two groups (male, female), which also yielded a non-significant group effect, $t = 1.13$, $p = 0.27$, suggesting that boys and girls made comparable gains.

Age
No association emerged between age (in years) and SCARED-P change, $r^2 = 0.014$, $p = 0.24$, beta = -0.78, yielding no evidence of an age effect in the current sample.

Ethnicity
As shown in Table 1, the majority of participants identified as white (78.5%), with 21.5% identifying as racialized. One-way ANOVA with ethnicity as the grouping factor (and SCARED-P change as the dependent variable) was non-significant, $F(3,89) = 1.86$, $p = 0.14$.

Parent education
Parents reported their highest educational level attained (for the primary caregiver, and highest across caregivers). We report findings based on primary caregiver's education for these analyses (although results did not differ when using highest level across caregivers). As depicted in Table 1, families' education was fairly evenly distributed between those who had received a post- graduate education or professional degree (34.7%), received 4-year university or college degree (29.6%), or had attended some college or a 2-year college degree (29.6%); just over 6% had completed high school or less. ANOVA revealed a significant group effect, $F(3,94) = 3.75$, $p = 0.014$, $\eta_p^2 = 0.11$. Post hoc analyses revealed only one significant sub-group difference, indicating greater gains for families with some college or a 2-year degree (M SCARED-P change = −11.02), compared to those with a post-graduate education or professional degree (M SCARED-P change = −3.16), $t = -3.32$, $p = 0.007$.

Caregiver self-efficacy
To explore parents' self-efficacy, we combined two items from the Anxiety Impact questionnaire: "How effective do you feel…" and "How confident do you feel at managing your child's feelings of anxiety?" Self-efficacy increased significantly from baseline ($M = 6.98$, $SD = 2.77$) to post-intervention ($M = 10.08$, $SD = 2.60$), $t = -8.16$, $p < 0.001$, ES = -1.15. Linear regression revealed that parents' change in self-efficacy was significantly inversely associated with changes in child anxiety ($r^2 = 0.109$, $p = 0.002$, beta = 2.01); namely, increased self-efficacy was associated with reduced child anxiety over time.

COVID-related influences
Four COVID-related domains were used for these analyses, informed by the domains of the CRISIS and CRISIS-AFAR: (1) **Material deprivation** was based on 5 items assessing actual or perceived concerns related to financial problems, housing and food stability, lost employment, and lost earnings potential (per [41]). (2) **COVID-stress** included 7 items (5 from CRISIS and 2 from CRISIS-AFAR Co-occurring Behaviours domain)[40] regarding the child's perceived stress associated with leaving the home, cancellation of important events (social isolation), worry about self or others being infected, worries about physical health and mental/emotional wellbeing, and time spent investigating (asking, reading, watching content) about COVID-19. (3) **COVID-illness** was derived from 2 items: "Has your child been suspected of having COVID-19 infection?" and "Has anyone in your family been diagnosed with COVID-19?" (per [42]). Finally, (4) **Positive outlook** comprised 2 questions: "Has the COVID-19 crisis led to any positive changes in your child's life?" and "How hopeful is your child that the COVID-19 crisis in your area will end soon"? pulled from the Life Changes domain of the CRISIS[40].

Individual linear regressions revealed two significant predictors, **positive outlook** ($r^2 = 0.049$, $p = 0.027$, beta = 1.765; i.e., lower baseline positive outlook predicted greater improvement in anxiety) and **material deprivation** ($r^2 = 0.041$, $p = 0.044$, beta = 0.860; i.e., greater baseline material deprivation predicted greater reduction in anxiety). None of the other COVID-related factors was significantly associated with treatment response when examined individually. For both positive outlook and material deprivation, the effects were opposite to our hypotheses. They were thus contextualized by examining concurrent associations between each factor and baseline anxiety (rather than *change in* anxiety) using bivariate correlations. This association was strong for material deprivation ($r = 0.30$, $p = 0.0025$; i.e., more material deprivation was associated with higher anxiety symptoms), but not for positive outlook ($r = -0.11$, $p = 0.30$).

Predictors of treatment response–II. Hierarchical regression

A hierarchical regression examined the relative role of eleven putative predictors of treatment response, while controlling other variables (see Table 2). First, four key socio-demographic variables were entered into the model (child age, sex, ethnicity, parents' education). Next, we entered the three main baseline clinical measures (SCARED-P, ABAS-II, and SCQ). In the final step, four variables were added (3 of which had emerged as promising from the individual linear regressions: self-efficacy, COVID-related material deprivation, and positive outlook; and we included COVID-related stress, based on previous findings[21,32]).

The first three demographic variables (age, sex, ethnicity) were not significant predictors, together explaining only about 5% of the variance in treatment response (p's > 0.10). Adding parental education increased the amount of explained variance to > 14%, but this did not survive error correction ($r^{2\text{delta}} = 0.09$, $p = 0.023$, with critical p set to 0.0045). Beyond the influence of demographic variables, baseline SCARED-P contributed significantly to the model, explaining 14% of the unique variance ($r^{2\text{delta}} = 0.14$, $p = 0.001$). All remaining variables contributed significantly to the model (p's < 0.0045) with ABAS-II, SCQ, parent self-efficacy, and positive outlook each adding 1–2% of explanatory power to the model. COVID-related material deprivation and stress, although significant, each accounted for less than 1% of the variance in treatment response.

Variable	r^2	F Statistic	P value*	r^2 delta
Child/youth age	0.014	1.418	0.226	–
Sex of child/youth (binary)	0.027	1.273	0.284	0.012
Ethnicity (binary)	0.057	1.746	0.163	0.031
Parent education	0.143	2.778	0.022	0.086
SCARED-P (BL)	0.282	5.373	<0.001	0.139
ABAS-II GAC	0.303	5.025	<0.001	0.021
SCQ-total	0.318	4.671	<0.001	0.016
Parent self-efficacy (BL)	0.340	4.525	<0.001	0.022
COVID-related positive outlook	0.353	4.255	<0.001	0.013
COVID-related material deprivation	0.355	3.847	<0.001	0.002
COVID-related stress	0.356	3.501	<0.004	0.001

Table 2. Hierarchical regression results. Variables appear in the order in which they entered the model. *Critical p was set at $p < .0045$ (.05/11).

Discussion

We delivered a virtual adaptation of an established CBT program for anxiety in autism, examining the feasibility and efficacy of its implementation. As hypothesized, youth with ASD and anxiety experienced an overall reduction in anxiety symptoms following virtual delivery of *Facing Your Fears*, a group CBT program adapted specifically for autistic children and youth, with minor adaptations for virtual delivery. Reduced anxiety symptoms were reported both by caregivers and the youth themselves, and significantly fewer children met criteria for clinically significant anxiety following the program. Parent-reported improvement in their child's overall anxious symptoms was characterized by a medium-sized effect. This mirrors previous reports from tightly controlled research settings[11–15] and was almost identical in magnitude to that reported recently in an in-person community implementation of the same program[21]. The size of this effect was somewhat surprising, given the virtual delivery of the program and our sample's characteristics (i.e., high ASD characteristics/symptoms and low adaptive functioning).

Capitalizing on the efficiency of virtual delivery, we were able to enroll families from across the province of Ontario, which has a geographical area of over 1 million square kilometers, representing all but one regional health authority and demonstrating good geographic reach. We were not able to engage community members in one region (North-West) which encompasses a large geographic area, but only 2% of the provincial population, many of whom are from First Nations (Indigenous) communities.

Accessible, safe, and culturally informed healthcare for Indigenous people has been identified as a health priority in Canada, along with the urgent need to include Indigenous communities in current mental health research (e.g., see[43]). With these priorities in mind, we succeeded at engaging one group facilitator (a registered clinical psychologist) from one such community in the North-Western region of Ontario. Through this engagement, we were alerted to the important perspective that CBT-based programs may not always be aligned with community values or priorities due to questions of whether trauma-informed practices are used when CBT approaches are implemented. This may have created a significant barrier to recruitment in the current study. While there may be other barriers to participation (e.g., logistical issues such as access to laptop/computer, internet connection, access to ASD diagnostic assessment) that affected the feasibility of the program, it remains possible that a program such as this was not as valued in the North-West region due to such barriers. Collaboration and co-design of treatment approaches with Indigenous community members, including individuals with lived experiences (e.g., autistic youth, caregivers and elders), may increase the sense of culturally safety and acceptability of mental health interventions for Indigenous autistic children and youth.

Our sample included a socio-ethnically diverse range of families, with over 20% identifying as racialized, and a range of caregiver educational levels. We do acknowledge that the current sample was relatively highly educated, with one-third of the parents having received a post-graduate education and only six caregivers indicating that they concluded their schooling at the high school level or below. When examined individually, there appeared to be an effect of parent education on treatment response. However, when entered into the hierarchical regression model, parental educational attainment was no longer significant, which suggests that formal educational attainment of caregivers did not emerge as a unique predictor of treatment outcome (i.e., other predictor variables better accounted for variance in treatment outcome).

Caregivers found the virtual delivery of the program acceptable and feasible. The program received strong satisfaction ratings in all areas explored, including the virtual delivery format. Caregivers also reported large gains in self-efficacy with respect to caring for their anxious children. These feelings of efficacy likely reflect caregivers' high levels of involvement in the intervention, which includes specific training and practice with managing their children's anxious symptoms. Feelings of self-efficacy may also be attributable to the social supports associated with participation in a group with parents experiencing similar life events[44], with potential to positively influence the amount of effort and persistence parents are willing, or able, to expend on the program[45].

The program was also feasible for families, with high retention rates; 87% of participating families completed the program and provided post-intervention data. Program compliance, as measured by attendance at virtual sessions, was very good, with 83% of families attending the majority of sessions (i.e., 75% of the program; missing

no more than three of 12 sessions). Good compliance and retention may be explained by the ease of program attendance (families did not have to leave home to attend the virtual sessions), but they also speak to the value of the program to participating families. It was unexpected that session attendance did not predict treatment response, although this may be due to the skew toward high attendance for most families.

We examined several putative predictors of treatment response in an attempt to identify child/family characteristics that would indicate best fit for the program. The strongest predictor was children's baseline anxiety as reported by parents–higher baseline anxiety symptoms predicted greater improvements in response to the program. This may be a function of having more room for improvement (vs. children starting with lower levels of anxiety who may experience a floor effect), but it mirrors previous findings[21], and may even point to the possibility that virtual groups may be less anxiety-provoking and place fewer demands on an autistic child's social-communication skills compared to in-person programs. Other predictors, with small but significant impact, included children's baseline adaptive functioning (ABAS-II) and autism symptoms (SCQ), each contributing approximately 2% unique explanatory power to the model. These findings revealed a slight advantage for children who began the program with relatively *lower* adaptive functioning and more ASD symptoms. The current findings stand in contrast to previous efforts to identify predictors in a large community sample, wherein neither baseline IQ nor ASD symptomology was predictive of response to treatment[21]. One possibility for this discrepancy is that the vast majority of participants in Solish et al.[21] had IQ > 80, with mean IQ well within average limits and relatively little variability. By contrast, we screened here for broadly average cognitive ability, based on parent report, and formally measured adaptive function (rather than IQ) as an index of general "developmental ability." This may have yielded a more diverse sample that included children/youth with functional levels within the range of intellectual disability (i.e., two-thirds of participants had ABAS GAC < 70 indicating significant delays in adaptive functioning). Caregiver ethnicity and educational attainment did not contribute significantly to the hierarchical regression model, but our measure of self-efficacy did. Parents' reports of improved self-efficacy (i.e., effectiveness and confidence) were associated with reduced child anxiety. Thus, youth anxiety decreased as parents felt better equipped to manage their child's anxiety. As caregivers continue to support their children beyond the timeframe of the program, there is potential for long-term impact for the youth themselves as well as their caregivers[46]. It remains possible that virtual mental health interventions have unique predictors of treatment outcome compared to in-person interventions. Although this is beyond the scope of this study, future research could look to compare medicators/moderators of treatment outcome for in-person vs. virtual modes of treatment delivery, which might help to make personalized programming recommendations.

We explored the impact of COVID-related factors on treatment response, hypothesizing that COVID-related hardships might reduce a family's ability to engage in and benefit from the program. After controlling for socio-demographic and baseline child characteristics, children's worries or experiences of material deprivation associated with COVID-19 and family stress both negatively predicted response to treatment (i.e., greater baseline concerns predicted slightly increased response to treatment), whereas higher baseline positive outlook predicted reduced treatment response. These findings warrant further investigation, as the predictive value of COVID-19 factors over and above socio-demographics and clinical features was very small and may be an artefact of associations between child baseline anxiety and COVID-related factors. Nonetheless, findings demonstrate that these COVID-related hardships did not impede families' ability to benefit from the program. Conversely, caregivers experiencing these hardships were able to benefit slightly *more* from the program. Together with recent evidence that families with greater worries about material deprivation were more likely to access urgent mental health services[32], this suggests that perhaps COVID-related hardships bolstered caregivers' motivation to seek mental health supports for their children and help them make positive change.

Alternatively (or additively), there may have been other psychological factors at play, such as distraction away from issues that are causing distress, or shifting to focus on things that are within the family's control. These findings highlight the program's value even during a challenging global pandemic when rates of anxiety in children youth evidenced a sharp and concerning rise[47].

Strengths and limitations

Strengths of this study include a large sample, recruited from all but one public health regions geographically dispersed across a large province in Canada. The involvement of interdisciplinary community-based mental health providers, with oversight and supervision from a centralized expert team, allowed for rapid dissemination of the program across the province. Our sample was diverse in terms of child age, adaptive function, ASD symptoms, and levels of anxiety. Parents had a range of educational attainment, and over 20% of the sample identified as racialized. The retention rate was very high, suggesting that our findings are not limited to a select sub-group of families who were able to complete the full 12-week program, thus supporting the generalizability of our findings.

Limitations include the absence of a control group—although the current objective was to demonstrate the acceptability and effectiveness of virtual delivery rather than its efficacy per se. Moreover, although we collected data from parents and children/youth themselves, we did not have independent or blinded measures of outcomes. Objective ratings from therapists or teachers, based on observed behaviour, might strengthen the conclusions, although third-party reports of internally experienced anxiety symptoms can also be limited. In addition to the use of well-validated measures, we included two non-validated measures (the Anxiety Impact Questionnaire and the Satisfaction Questionnaire) to explore aspects of children's anxiety and parents' satisfaction with the program, which were not available using existing validated measures.

Future work would benefit from examination of long-term impacts of the anxiety reductions that emerged at the end of the program. In terms of reach, we acknowledge that families from the North-West health region in Ontario did not spontaneously engage with us, and we acknowledge that our ability to provide service only in

English was a further limitation. Priorities for ongoing work include working with Indigenous communities to co-design supports that are culturally safe and aligned with community values, and recruitment and training of multi-lingual mental health professionals in manualized programs such as *Facing Your Fears*.

Conclusions

Autistic children and youth experience high rates of interfering anxious symptoms and anxiety conditions, making treatment a priority for clinical care. Modified cognitive behavioural therapy (CBT) programs for autistic youth have demonstrated efficacy based on well-controlled research studies and community implementation, when delivered in-person. We adapted an evidence-based modified CBT program (*Facing Your Fears*) for virtual delivery and implemented the program with a large sample of children and youth with ASD, aged 8 to 13 years, and their parents/caregivers. The greatest predictor of treatment response was the youths' baseline anxiety, and a small but significant advantage emerged for youth with lower adaptive function and more ASD symptoms at the start of treatment. COVID-related hardships did not interfere with families' ability to benefit from the program. This study demonstrates the promise of virtual delivery of CBT interventions for autistic youth, both during and beyond pandemic isolation measures. Virtual delivery of evidence-based mental health intervention for youth with ASD holds promise for increased access, with potential to enhance outcomes and quality of life for these youth and their caregivers. Moreover, findings speak to the appropriateness of the program for a wide range of children and youth, including those with relatively low adaptive functioning, and families from a range of sociodemographic backgrounds and geographic regions.

Although not examined formally, our virtual supervision and oversight model is an innovative and feasible approach to community capacity building. We used a hub-and-spoke model to leverage clinical expertise from a specialized centre, with a lead clinician and clinical team providing oversight to providers from regions at a distance, as well as mentorship to trainees. Such an approach has potential to exponentially increase access for families in remote and underserved regions.

Finally, the exploration of implementation factors can inform practice and policy decisions regarding the provision of mental health supports to autistic individuals and their families. In light of rapidly increasing rates of anxiety experienced by youth during (and persisting beyond) the pandemic[47], and well-documented barriers to bringing evidence-based interventions into real-world clinical practice[48], the current work offers a promising and innovative approach to meeting these challenges.

Data availability

The raw data contributing to the analyses described herein will be made available by the authors upon reasonable request, consistent with the requirements of our research ethics board.

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Author contributions

Authors contributed to the manuscript in the following ways: EA (senior author and grant PI), JB, AS, and JL made substantive contributions to the conception and design of the project and interpretation of findings; AS, JL, BD, KMF, LB, MO, ED, ZT, SP, MP, NK, ML, VC, JJL, RH, RB, and RHA contributed to running the groups and acquisition of data; KL, LG, and ES contributed to recruitment, enrollment, data acquisition and entry; and JN conducted the data analyses. JB wrote the majority of the manuscript; all authors reviewed the manuscript and have agreed to be personally accountable for the accuracy and integrity of any part of the work.

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Declarations

Competing interests

EA reports the following potential conflicts: Grants from industry (Roche, SynpDx, Maplight, Anavex; Sanofi Aventis), consultations (ROChe, Ono, Impel, Cell-EI, Quadrant) and in-kind supports (AMO pharma, CRA), editorial honoraria/ book royalties (Wiley, APPI, Springer), and a patent (Anxiety Meter). All other authors declare that the research was conducted in the absence of any commercial or financial relationships that could be perceived as a potential or actual conflicts of interest.

Ethics statement

This study involving human participants was approved by the Research Ethics Board at Holland Bloorview Kids Rehabilitation Hospital. The study was conducted in accordance with local legislation and institutional requirements. Participants provided written informed consent as described in the manuscript.

Additional information

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