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Efficacy of a Telehealth Parent Training Intervention for Children with Autism Spectrum Disorder: Rural versus Urban Areas

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ABSTRACT
Parent-mediated interventions are increasingly described in the current literature, and although parents of children with autism spectrum disorder (ASD) face many challenges in regards to behavioral concerns, there are few parent-mediated interventions that target behavioral problems. There are even fewer that are evaluated for use in rural communities where service access is limited. As such, telehealth-based interventions can be effective in addressing the unmet needs in rural areas. COMPASS for Hope (C-HOPE) is an 8-week parent-mediated intervention that enhances parent competency and reduces parent stress and child problem behavior in children with ASD. In this treatment, parent behavior management and competency are essential to determine the efficacy of C-HOPE. The purpose of this study was to compare the outcomes of telehealth-implemented C-HOPE for rural (n = 12) versus urban (n = 8) parents of children with ASD (3–12 years old) with a focus on parent competency, knowledge, and activation, as well as child problem behaviors. Significant effects were noted in each area. Future directions for telehealth in this population are discussed.

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder comprised chiefly of deficits in communication and social skills and the presence of restricted interests and repetitive behaviors. According to the Centers for Disease Control, it is estimated to impact about 1 in 59 children in the United States (Maenner et al., 2020), affecting the individual's developmental trajectory. Early identification and intervention can improve functional outcomes for children with ASD (National Research Council (US). Committee on Grand Challenges in Environmental Sciences, 2001), but access to such services is not equal across all demographic groups. Rural communities face significant challenges regarding the availability and adequacy of services for children with ASD due to barriers such as financial challenges, geographic location, fewer resources, and general apprehension or the mental health stigma and hesitation toward outside professionals (Antezana et al., 2017; Scarpa et al., 2020). Also, families of children with ASD report more instances of job loss, especially for low-income and families of diverse backgrounds (Liptak et al., 2008; Magaña et al., 2012; Mandell et al., 2009; Papoudi et al., 2020). Specifically, communities in rural Appalachian areas experience unique barriers of availability and affordability of diagnostic and intervention services, caregiver support, and trained ASD providers (Scarpa et al., 2020), greatly affecting the ability to utilize and benefit from services in rural areas. Additionally, compared to parents of typically developing children, parents of autistic children report higher levels of stress (Hayes & Watson, 2013) compared to parents of children without ASD, which is often greater in families of rural, underserved communities (Antezana et al., 2017). As such, there is a clear need for research-supported, efficient, and cost-effective methods for delivering ASD services to rural and diverse communities.

Previous research has examined technology as a means to reduce service access barriers and deliver services for children with ASD in geographically distant areas such as rural Appalachia. Telehealth, which is the delivery of services using information and communication technology, is a proficient approach for providing assessment

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and intervention services in a cost-effective way (Ashburner et al., 2016).

Behavior problems in ASD

Children with ASD often engage in disruptive behaviors, such as aggression, high levels of frustration (i.e., screaming, yelling), self-injurious behavior, tantrums, meltdowns, destruction of property, and overall emotion regulation difficulties. These behaviors often occur very early on in life and can continue to persist through development and becoming more interfering and challenging if not treated effectively and as early as possible in the child's life (Aman et al., 2009). These interfering behaviors can also lead to difficulties in family functioning, especially in areas of parenting stress (Hastings et al., 2005).

Parent training

Research shows that parents can effectively learn behavioral and developmental-based strategies for ASD that have a positive impact on child development (Brookman-Frazee & Koegel, 2004; Rocha et al., 2007). Parent training programs for children with ASD have indicated positive language and behavioral outcomes in children (Bearss et al., 2015) as well as increased parental skills, confidence, and knowledge of appropriate evidence-based strategies (Hardan et al., 2015; Hassenfeldt et al., 2015; McConachie & Diggle, 2007). For example, pivotal response treatment (PRT), which often focuses on parent education as the core framework of service delivery, capitalizes on training parents to work on pivotal skills in natural environments, leading to widespread improvements in children (L. K. Koegel et al., 2005) and increased parent-child interactions, decreased parental stress, and increased parental positive affect and satisfaction (R. L. Koegel et al., 1996).

Further, having a child with ASD impacts parents and other family members, more so than with children with other disabilities (Hayes & Watson, 2013). While many treatment programs focus on child outcomes, parent outcomes are also important to target, as parents are essential in the maintenance and generalization of treatment skills over time. Specifically, research on the constructs of parent activation, parent competency, and parent knowledge are key targets that can help parents of children with ASD better navigate their child's services (Kuravackel et al., 2018). Activation is defined as having information, beliefs, confidence, knowledge, and motivation necessary to be an active participant toward improving one's symptoms and health care (Hibbard et al., 2004). In terms of parent knowledge and competency, education for parents of children with ASD has been known to improve both parent and child outcomes (Bearss et al., 2015), which can positively impact other effects, such as knowledge, stress, and perceived competency (McConachie & Diggle, 2007). Although these constructs are important and are targeted in some parent-assisted treatments, there are very few that are utilized in an intervention that focusing on behavioral management strategies in a group setting (Kuravackel et al., 2018).

Telehealth treatments for ASD

Utilizing telehealth as a service delivery model for remote areas makes it possible to implement ASD interventions efficiently. For example, the Online and Applied System for Intervention Skills (OASIS; Buzhardt & Heitzman-Powell, 2005) training program combines online instruction with hands-on practice of evidence-based behavioral techniques for service providers working with children with ASD. Heitzman-Powell et al. (2014) examined the modification of OASIS for caregivers of children with ASD in remote areas. This included an integration of online tutorials with "parent-friendly" language and web-based video calls for in-vivo coaching. Results indicated that the OASIS was effective in training caregivers asynchronously without the need of outside providers. Post-intervention results indicated an increase in knowledge of ASD and Applied Behavioral Analysis (ABA) concepts, increase in ABA implementation skills, high satisfaction with training, and less costs associated with traveling to a local telehealth site versus a geographically distant mental health center to receive services.

Another intervention, known as COMPASS for Hope (C-HOPE: Collaborative Model for Promoting Competence and Success; Kuravackel et al., 2018), is an adaptation of the original school-based COMPASS for students with ASD (L. A. Ruble et al., 2012), which has shown promising results. In a randomized controlled trial (RCT) of COMPASS in schools, L. A. Ruble et al. (2010) found that children whose teachers received COMPASS were able to reach educational goals at a significantly higher level than children enrolled in treatment as usual (*d* = 1.5). A second RCT implemented a telehealth delivery of COMPASS (L. A. Ruble et al., 2013), which also demonstrated efficacy compared to treatment as usual (*d* = 1.1). Additionally, one of the primary goals of C-HOPE is to increase parent competence, which has been shown to decrease stress (Hayes & Watson, 2013; L. Ruble et al., 2018). This is important given that parent-implemented interventions may place additionally stress on caregivers. The authors noted that C-HOPE was able to address parent stress effectively by targeting stress relief strategies during group sessions (Kuravackel et al., 2018).

C-HOPE is an 8-week parent-mediated intervention consisting of individual and group sessions. The focus of the C-HOPE treatment approach is threefold: (a) to increase parent competency; (b) decrease child problem behaviors; and (c) decrease parent stress through psychoeducational activities that enhance caregiver knowledge, behavior management skills, and supportive strategies. These strategies, which are specifically for caregivers of autistic children, are also accompanied by personal strategies that can help caregivers improve their well-being and decrease parenting stress.

COMPASS personalizes behavioral interventions for children with ASD and families because it is based on an evidence-based practice in psychology framework (McGrew et al., 2016) that informs clinical decision-making from the overlapping influences of child and family preferences and strengths, parent and family resources, and evidence-based practices. COMPASS provides a holistic view of the child based on a profile assessment of development from the persons with the most frequent interaction with the child; in the C-HOPE intervention, the child's caregiver completes this assessment. The COMPASS profile is used to guide discussion of the child's personal and environmental challenges and supports (www.compassforautism.org) and helps identify the underlying meaning of behavior and thus, critical functional replacement skills for challenging behaviors.

As the only study to assess a group-format approach via telehealth technology, Kuravackel et al. (2018) examined the effectiveness of a telehealth-implemented C-HOPE approach. Caregivers who received the intervention reported a decrease in parenting stress, an increase in competence levels, and a significant reduction in in child behavioral problems. These results provide evidence that C-HOPE could be effective for rural families with a child diagnosed with ASD, regardless of whether the treatment was delivered via face-to-face or telehealth. Additionally, this study noted that both the therapeutic alliance between caregivers and clinicians and the caregiver-reported satisfaction were rated highly regardless of the treatment modality. This provided evidence that the C-HOPE treatment could be reliability adapted across either face-to-face or telehealth approaches.

Telehealth-implemented C-HOPE includes the essential components of online training and instruction, fidelity and outcome assessments, as well as individual and group coaching. Because C-HOPE is accessible in remote areas via a supportive teleconference setting for group sessions in addition to tailored one-on-one individual sessions provided over the phone, it has the potential to be a feasible and effective treatment program. The use of the telehealth-implemented C-HOPE to deliver ASD services is promising in that it can lead to further dissemination and implementation of evidence based services in rural or remote areas, as parents will have the opportunity to be supported to serve as the primary interventionist for their children. Using telehealth techniques can address barriers among people in rural communities by while increasing access to resources in the comfort of their own home.

The current study

Preliminary studies indicate C-HOPE is effective for supporting parents with behavior management concerns by increasing competency, decreasing parenting stress, and decreasing child problem behaviors (Kuravackel et al., 2018), but these outcomes, in addition to parent activation and knowledge have yet to be differentially examined in rural versus urban groups. The purpose of this study is to examine the outcomes of C-HOPE, delivered via telehealth, with emphasis on rural versus urban communities in order to evaluate if benefits are seen across both settings. Due to the lack of resources available in rural areas, research on rural versus urban communities will provide new information to help communities in need of access to effective, evidence-based treatments. The aim is to identify whether differences in treatment outcomes were observed for C-HOPE telehealth-delivery in rural versus urban communities.

Based on prior research (Kuravackel et al., 2018; L. A. Ruble et al., 2013; L. Ruble et al., 2018), it was expected that the telehealth implemented C-HOPE would result in a pre- to post- decrease in child problem behaviors and increase in parental activation, perceived competence, and knowledge across both rural and urban groups.

Method

Participants

This is a secondary analysis of the original C-HOPE study (Kuravackel et al., 2018) with parents and their children with ASD, who were randomized to receive the telehealth-based modality. The study occurred over an 18-month period at four locations (two rural sites and two university sites) through the University of Louisville School of Medicine and the University of Kentucky.

Participants were recruited through various methods, including flyers posted at the two university sites and support group websites. Eligibility criteria included the following: (a) the child's age must be between 3 to 12 years; (b) the child must have a DSM-IV or DSM-5 diagnosis of ASD verified by the *Autism Diagnostic Observation Schedule, 2nd Edition* (ADOS-2; Lord et al., 2012); (c) the child must be receiving special education services under the eligibility category of ASD; and (d) the child must be experiencing at least one of the following target problem behaviors: noncompliance, aggression/tantrums, escape behaviors, rigid behaviors, or inappropriate social initiations. Additionally, the participants agreed to the following: random assignment to a condition, audiotaped sessions, commitment to activities related to the condition, and no plans to relocate during the timeframe of the study. Parents and their children completed a screening process which include the completion of the *Modified Checklist for Autism in Toddlers* (M-CHAT; Robins et al., 2001) or *Social Communication Questionnaire* (SCQ; Rutter et al., 2003), in which the M-CHAT was administered for children less than 4 years of age and the SCQ was administered for children 4 years of age or older. This screener was followed up by an intake appointment to confirm a diagnosis of ASD, pending the child's eligibility based on either of the screening measures. Informed consent was obtained from all participants included in the study.

Thirty-three parents ($n_{\text{Males}} = 7$, $n_{\text{Females}} = 26$) with children from 3–12 years of age ($M = 8.17$, $SD = 2.5$) and a prior diagnosis of ASD were sampled from two rural sites and two urban sites (rural $n = 12$, urban $n = 21$) in Kentucky. Forty-four percent of sampled families represented single-parent homes. The participants were randomly assigned to waitlist control (WLC; $n = 10$), C-HOPE telehealth (TH; $n = 10$), and C-HOPE face-to-face (FF; $n = 13$). The participants in the waitlist condition later received the C-HOPE telehealth treatment.

Because the current research questions only concerned the telehealth group, the 20 participants (WLC $n = 10$; TH $n = 10$) who received the C-HOPE telehealth treatment were included for analyses. Of these, the sample was divided into rural ($n = 12$) and (urban $n = 8$) groups, based on their area of residence. The rural settings were located in eastern and southeastern Appalachia of Kentucky. These locations were considered rural because they were located about 120 miles from a center that offered specialized ASD services. The children ($n_{\text{Males}} = 15$, $n_{\text{Females}} = 5$) ranged from 3–12 years of age ($M = 7.67$, $SD = 2.68$), and were primarily White ($n = 17$). Most households consisted of two-parents (mother and father $n = 13$; parent and stepparent $n = 2$), but also included single-parent (mother only $n = 4$) homes. One participant in the rural group did not report on number of caregivers in the home. Caregiver years of education ranged from 12–18 years ($M_{\text{mother}} = 15.12$, $SD_{\text{mother}} = 2.03$; $M_{\text{father}} = 14.00$, $SD_{\text{father}} = 2.24$). Two participants in the urban group and one participant in the rural group did not report caregiver education. Family total household income level was reported based on the selection of one of five categories: less than 10,000 USD ($n = 1$), 10,000 USD-$24,999 ($n = 4$), 25,000 USD-$49,999

Table 1. Demographic variables.

	Rural (n = 12)	Urban (n = 8)
Child Age in Years [M *(SD)*]	7.16 *(2.39)*	8.44 *(2.72)*
Male (*n*)	9	6
Single-Family Homes (*n*)	2	2
Mother Education in Years [M *(SD)*]	15.18 *(1.99)*	15.00 *(1.91)*
Father Education in Years [M *(SD)*]	13.64 *(2.06)*	14.67 *(2.21)*
Family Household Income (%)		
Less than $10,000	9.1	0
$10,000-$24,999	9.1	37.5
$25,000-$49,999	45.5	12.5
$50,000-$100,000	27.2	50
$100,000 or more	9.1	0
Race (%)		
White	100	62.5
Black	0	25
Asian/Pacific Islander	0	12.5

($n = 6$), 50,000 USD-$100,000 ($n = 7$), or 100,000 USD or more ($n = 1$). One participant in the rural group did not report household income. See Table 1 for the breakdown of this demographic information by group.

Treatment was conducted by two licensed clinical psychologists and two trained doctoral students in school psychology. Group sessions were conducted at a distance education center with the help of research assistants, and individual sessions were conducted over the phone and allowed for one-on-one discussions with the treatment facilitator in order to work on individualized goals for each participant.

Description of the C-HOPE intervention

The C-HOPE curriculum included activities that facilitated parent-to-parent engagement, parent knowledge, and behavior management skills. Treatment included 8 sessions, which included a combination of 4 group sessions and 4 individual sessions (See Table 2 for session content; Kuravackel et al., 2018). Group sessions were about 2 hours in length, in which the group facilitators provided information about ASD, including learning differences, which could impact their child's behavior and communication skills. Parenting stress, psychological well-being, and coping strategies were also discussed. The individual sessions were 1 hour in length and focused on the development and implementation of each participant's behavioral plan, in order to effectively target the goal problem behaviors. Assessment of treatment fidelity scores was at 80% or higher for both conditions, indicating the reliability of implementing C-HOPE across both modalities (Kuravackel et al., 2018).

Table 2. C-HOPE session content (from Kuravackel et al., 2018).

Session Number	Session Type	Session Content
1	Individual	Overview of C-HOPE and its goals, assessment and initial goal identification using the COMPASS profile
2	Group	Introduction of parents and their child to the group based on an assessment of social, communication, and other behaviors. Discussion of unique and common characteristics of each child. Overview of cognitive theories of autism (central coherence, theory of mind, executive function) and how these relate to behavior, and local autism services and resources. The session is concluded with introduction of a relaxation strategy.
3	Group	Direct education on principles of behavior and learning as well as proactive and reactive strategies.
4	Individual	Development of the child's personalized behavior plan using the COMPASS framework. Once the disruptive behavior is identified, the replacement skill is generated.
5	Group	Discussion of teaching strategies, positive behavior approaches to prevent disruptive behaviors, teach new skills, and respond effectively.
6	Group	Discussion of parents and caregivers as essential "environmental supports" for the child and the emotions associated with the diagnosis, parenting expectations, and transitions. A "wellness" package of activities designed to identify strategies for self-care and relaxation is reviewed.
7	Individual	Review of the individual behavior plan and how well it is working. Modifications to the plan may occur based on data tracking the child's problem behavior and new skills.
8	Individual	Pertinent skills from previous sessions are reviewed. Progress toward the goals is examined and any modifications needed are implemented. Anticipated barriers that might arise related to the implementation of the behavior plan are discussed as well as possible proactive strategies to overcome these issues following the intervention.

During the initial individual session (session 1), parents completed the COMPASS Profile (L. A. Ruble et al., 2012; https://compassforautism.org/build-a-compass-profile-2/), which was used to generate a shared understanding of the child at home and in the community, identify child problem behaviors and the possible function of the behaviors, leading to goals for treatment. The first group session (session 2) included a brief introduction of parents and their child, followed by the discussion of common characteristics amongst all the children in the group. The facilitators then provided an overview of the theories and behaviors related to ASD, local ASD services and resources, and parent relaxation strategies. The next group session (session 3) included education on the different principles of behavior and learning, including proactive and reactive strategies that can be used. After obtaining and discussing this information during these group sessions, parents then attended another individual session (session 4) to develop their child's behavioral plan using the COMPASS profile framework, in which the parents further clarified a specific behavioral problem and strategies. Session 5 included a group discussion of teaching strategies and positive behavioral approaches that can be used to prevent some of the aforementioned behavioral problems as well as methods for teaching new replacement skills. Session 6 discussed the idea of parents being "environmental supports" for their child and how to manage the emotions and thoughts related to the ASD diagnosis. With that, the parents created a "wellness package "that includes activities of self-care and relaxation. During the final sessions (sessions 7 and 8), parents met individually with the treatment facilitators to review the effectiveness of the behavioral plan and make modifications as needed. They also reviewed the previously learned skills and the progress made toward the set goal; possible barriers for implementing the behavior plans and solutions were identified.

Measures

The parents completed the following measures pre- and post-treatment:

A *demographic questionnaire* was given to parents to gather background information on the parents and their children. The following data were collected: child age, child gender, child ethnicity, services received by child, household income, caregivers' years of education, and the number of caregivers in the home. The present study used these variables to examine demographic differences between rural and urban groups.

The *Eyberg Child Behavior Inventory* (ECBI; Eyberg & Pincus, 1999) measures the intensity of child problem behaviors. The ECBI is a 36-item measure of problem behaviors in children ages 2–16 years of age. The items are rated on the Intensity and Problem Scales., and are rated on 7-point Likert scale (ranging from *Never* to *Always*), The total score calculated from the Intensity scale, which measures total frequency of the behaviors, was used for the analyses in the current study. The change score from pre- to post-treatment was also used; this was calculated by subtracting the pre-score from the post-score. Positive change scores indicate higher frequency of problem behaviors from pre to post-treatment, whereas negative change scores reveal a decrease in frequency of problem behaviors from pre- to post-treatment. The ECBI's test-retest reliability (> 0.75) and internal consistency are at high levels (> 0.90) (Funderburk et al., 2003).

The *Parent Activation Measure for Developmental Disabilities* (PAM-DD; Hibbard et al., 2004) assesses parent confidence and knowledge in taking action, beliefs in the importance of taking an active role, and persistence for overcoming barriers related to child's care. The PAM-DD was created as a parent-adapted version of the original PAM (Hibbard et al., 2004). The PAM achieves high internal consistency (0.85; Pennarola et al., 2011). In the PAM-DD, the items were slightly modified to reflect services used for children with developmental disabilities such as ASD. Items are scored on 4-point Likert scale (ranging from *Disagree Strongly* to *Agree Strongly*), and summed to create a weighted score, in which higher scores indicate higher activation. The internal consistency on the PAM-DD was 0.83. A change score from pre- to post-treatment on the PAM-DD was also included in the analysis, in which the pre-score was subtracted from the post-score. Positive change scores indicate improved parent activation from pre to post-treatment.

The *Being a Parent Scale* (BPS; Johnston & Mash, 1989) measures parent's views of their own competence in the parenting role. The BPS is a 16-item questionnaire that includes questions categorized in two dimensions: satisfaction with the parenting role (9 items) and feelings of self-efficacy as a parent (7 items). These items are scored on a 6-point Likert scale (ranging from *Strongly Disagree* to *Strongly Agree*), and are given a total score. The total score and the pre to post-change score were used in this study. The change score was calculated by subtracting the pre-score from the post score, and positive change scores indicate higher perceived competence in parents from pre to post-treatment. The internal consistency of the BPS is 0.82 (Whittingham et al., 2009).

Additionally, parents completed the *Parent Knowledge Questionnaire* (PKQ) to assess parents' knowledge of parent training and supportive strategies, which was developed by the principal investigators of the current study. The PKQ is an 18-item scale that is scored on a 4-point Likert scale (ranging from *Not Much* to *Very Much*). Each item listed a specific parenting strategy or behavioral principle that was taught during the C-HOPE program. This measure was scored based on how many items were endorsed, indicating how much parents' knowledge increased as a result of the C-HOPE program from pre- to post-treatment. Both the total score and the change score from pre-to post-treatment were used in the current study. The change score was calculated by subtracting the pre-score from the post score, and positive change scores revealed an increase in parent knowledge from pre to post-treatment.

Data analysis plan

Due to the small sample size, an exploratory analysis was conducted to examine treatment outcomes in rural ($n = 12$) versus urban ($n = 8$) participants. The following analyses were conducted: (1) Chi-square tests, Mann-Whitney U tests, and independent t-tests to examine differences in the rural and urban groups at baseline (before treatment) on demographic variables (i.e., parent years of education, income, ethnicity, services received outside of school, number of caregivers per household), parental and child outcome measures; (2) Paired t-test analyses of parent data examined changes from pre- to post- treatment in the outcome variables, separately in the rural and urban groups; and (3) Correlational analysis examined if overall change in parent outcomes correlated with the change in child problem behaviors, parental activation, perceived competence, and knowledge across both rural and urban groups.

If differences in outcomes across rural versus urban groups were identified, analyses of baseline differences were explored, such as differences between the rural and urban groups in demographics (i.e., parent years of education, income, ethnicity, number of parents in the home services received outside of school), parent measures (i.e. knowledge), and child problem behaviors. Exploratory analyses also examined interrelationships among the parent measures and child outcome in order to understand possible mechanisms related to parental efficacy that may underlie change in child outcome.

Results

Baseline differences *(Table 3)*

Chi-square tests at baseline indicated no differences in ethnicity between groups $\chi(2) = 5.294$, $p = .071$; $d = .13$. This effect size (ES) was below Cohen's convention for a small effect ($d = .20$). Analysis of differences in enrollment in individual therapy services was found for more urban children enrolled in individual therapy than rural children $\chi(1) = 3.997$, $p = .046$; $d = .20$, indicating a small effect. However, there were no significant differences in whether children were enrolled in the following services: applied behavior analysis therapy $\chi(1) = 2.249$, $p = .134$; $d = .11$, physical therapy $\chi(1) = 3.333$, $p = .068$; $d = .17$, medical $\chi(1) = .003$, $p = .960$; $d < 0.1$, occupational $\chi(1) = .029$, $p = .865$; $d < 0.1$, or speech and language therapy $\chi(1) = 1.046$, $p = .306$; $d = .05$. The ES were all below Cohen's convention for a small effect ($d = .20$). Additionally, in terms of caregivers per household, only two participants in the rural group and two participants in the urban group were in single-parent homes, with the other 16 participants living with two caregivers.

Because the data for total income and parent years of education were not normally distributed, a Mann-Whitney U test examined income and parent education differences between both groups. Results showed no significant differences across rural and urban participants, with very small effects for income and mother's education, and small effects for father's education, according to Cohen's convention of ES (total household income: $U = 43$, $p = .931$; $d = .03$, mother years of education: $U = 31$,

Table 3. Baseline differences (independent samples T-test).

Baseline Variable	Rural Pre *M (SD)*	Urban Pre *M (SD)*	*t*	*Cohen's d* *(ES)*
BPS	23.17 (36.00)	48.67(28.56)	−.369	.22
PAM	45.50 (.71)	39.57 (3.74)	1.036	.29
PKQ	39.83 (22.56)	33.00 (21.37)	1.787	.99
ECBI	106.3 (55.62)	122.67 (25.40)	−.564	.29

BPS = Being a Parent Scale; PAM = Parent Activation Measure; PKQ = Parent Knowledge Questionnaire; ECBI = Eyberg Child Behavior Inventory; $^*p < .05$

$p = .362$; $d = .10$, father years of education: $U = 24.5$, $p = .836$; $d = .42$).

Descriptives of the percentages for participant ethnicity and services previously received outside of school across the two groups were also evaluated. In the rural group, 100% of participants identified as Caucasian. In the urban group, 62.5% of participants identified as Caucasian, 25% African American, and 12.5% Asian. For ABA therapy, 37.5% of urban participants and 8.3% of rural participants were enrolled. For speech and language therapy, 75% of urban participants and 91.7% of rural participants were enrolled. For occupational therapy, 62.5% of urban participants and 75% of rural participants were enrolled. 25% of urban participants were enrolled in physical therapy. For individual therapy, 50% of urban participants and 8.3% of rural participants were enrolled. Lastly, 37.5% of urban participants and 33.3% of rural participants previously received medical services. It is possible that the enrollment services could contribute to variations in treatment outcomes, which can impact baseline and post-treatment knowledge.

Independent t-tests were used to examine rural versus urban group differences in parent measures and child behaviors before treatment. Results from the independent t-tests can be found in Table 3. No significant differences between groups were noted for the parent measures of competence (BPS) $t\ (11) = -.369$, $p = .326$; $d = .22$, parent activation (PAM) $t\ (13) = 1.036$, $p = .453$; $d = .29$ and parent knowledge (PKQ) $t\ (13) = 1.787$, $p = .385$; $d = .99$, or child behaviors (ECBI) $t\ (15) = -.564$, $p = .566$; $d = .29$. Despite nonsignificance, however, ES for parent competence, activation, and child behaviors exceeded Cohen's convention of a small effect ($d = .20$), whereas the ES for parent knowledge exceeded that of a large effect ($d = .80$). As seen in Table 3, rural participants reported higher baseline scores on the PKQ and the PAM-DD compared to urban participants, but reported lower baseline scores on the BPS. Rural participants also reported fewer child behavior problems than urban participants prior to treatment.

Outcomes for rural and urban groups *(Table 4)*

Outcome results from pre- to post- treatment are in Table 4. Two-tailed paired sample t-tests were conducted to examine changes from pre- to post-treatment in the parent outcome variables using the pre- and post- scores of each measure, in order to examine the presence of significant change via effect sizes. Results revealed a significant mean pre- to post-increase in parent knowledge on the PKQ for urban, $t\ (8) = -3.925$, $p < .05$; $d = 1.31$, but not for rural families $t\ (5) = -2.529$, $p = .053$; $d = 1.03$, although the ES was large for both. There was no significant change in parent activation on the PAM for both urban, $t\ (6) = 2.413$, $p = .052$; $d = .91$, and rural families, $t\ (1) = -3.000$, $p = .205$; $d = 2.12$, although the ES was large for both, and means showed opposite patterns. This difference revealed decreased activation scores in the urban group, but increased activation scores in the rural group, following treatment. Parent competence, as measured by the BPS, also did not show a significant change in urban, $t\ (8) = -1.331$, $p = .220$; $d = .44$, or rural, $t\ (5) = -1.609$, $p = .169$; $d = .66$, participants, although the ES was small for the urban group and medium for the rural group in the direction of increased competence for both.

Table 4. Outcomes for rural and urban groups (paired sample T-test).

Outcome	Rural Pre *M (SD)*	Rural Post *M (SD)*	*t*	*Cohen's d (ES)*
BPS	23.17 (36.00)	64.00 (32.36)	−1.609	.66
PAM	45.50 (.71)	50.00 (2.83)	−3.000	2.12
PKQ	39.83 (22.56)	61.50 (8.26)	−2.529	1.03
ECBI	106.3 (55.62)	107.0 (30.48)	−.023	.01
Outcome	Urban Pre *M (SD)*	Urban Post *M (SD)*	*t*	*Cohen's d (ES)*
BPS	48.67(28.56)	63.89 (14.62)	−1.331	.44
PAM	39.57 (3.74)	37.00 (4.00)	2.413	.91
PKQ	33.00 (21.37)	61.33 (5.43)	−3.925*	1.31
ECBI	122.67 (25.40)	129.33 (23.22)	−1.066	.36

BPS = Being a Parent Scale; PAM = Parent Activation Measure; PKQ = Parent Knowledge Questionnaire; ECBI = Eyberg Child Behavior Inventory; $^*p < .05$

Relationships to change in outcome *(Table 5)*

Lastly, bivariate correlations were conducted for change in overall outcomes. A change score was calculated, subtracting the pre-scores from the post-scores on each measure, such that positive scores indicated increased parent competence (BPS), parent knowledge (PKQ), parent activation (PAM), and child behavior problems (ECBI). When examining change in parent and child outcomes, a significant negative correlation emerged between changes in parent competence and child

Table 5. Relationships to change in outcome (bivariate correlation).

		1	2	3	4
Parent Outcome	(1) PKQ Change	1			
	(2) PAM Change	.785	1		
	(3) BPS Change	.898	−.037	1	
Child Outcome	(4) ECBI Change	−.188	−.177	−.814*	1
Demographics	(5) Mo. Education	−.434	−.092	−.374	.340
	(6) Fa. Education	.305	.413	.359	.092
	(7) Ethnicity	.143	−.256	.258	.151
	(8) Income	.403	.331	−.781*	.146

PKQ Change = Parent Knowledge Questionnaire change score; PAM Change = Parent Activation Measure change score; BPS Change = Being a Parent Scale change score; ECBI Change = Eyberg Child Behavior Inventory change score; Mo. Education = Mother's years of education; Fa. Education = Father's years of education; Ethnicity = Race (Caucasian, African American, or Asian); Income = Total household income; *$p < .05$, **$p < .01$

behavior problems, $r = -.814$; $p < .05$, such that increased parent competence was associated with decreased child behavior problems (See Table 5 and Figure 1).

Discussion

This intervention study tested a technology-based implementation of a parenting intervention program called C-HOPE for children with ASD. This format is especially notable given the treatment outcomes are primarily focused on parenting outcomes in addition to child behavior outcomes. Following the C-HOPE telehealth treatment, it was expected that there would be a significant improvement in child behaviors, parent activation, perceived competence, and knowledge. The effects following treatment were expected to reveal overall improvements across both rural and urban groups.

Baseline differences

When examining services for families in rural and urban groups at baseline, only one significant difference emerged between the two groups. Specifically, significantly more urban participants were enrolled in individual therapy than rural participants, and this was demonstrated with a small ES according to Cohen's *d*. Thus, the randomization procedures were largely effective for equally distributing differences between the groups at baseline.

Surprisingly, the rural group reported fewer child behavior problems and greater parental knowledge prior to treatment compared to the urban group. Demographic data revealed no significant differences in ethnicity, income, and years of education, which was also unexpected. It is possible that the children from rural areas began treatment with fewer behavior problems that those from urban areas because rural parents had greater knowledge at baseline. Additionally, because parents were required to be able to travel to a telehealth

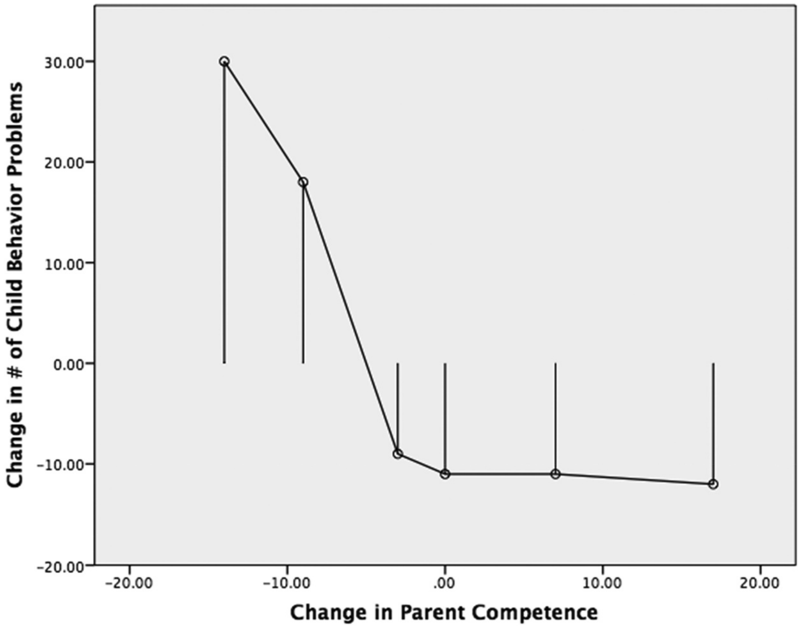

Figure 1. Relationship between change in number of child problem behaviors on the ECBI and change in parent competence on the BPS.

distance learning site, participation was likely more difficult for those with greater needs and at a great distance in rural areas. These findings, although small, indicate that there can be various individual differences across groups and cannot be stereotyped based on location (i.e., Appalachia).

In regard to treatment services previously received, as noted above, many rural and urban participants received similar services such as speech and language therapy, occupational therapy, and medical services, and only a few families receiving individual therapy services. This lack of experience with psychological therapy services may have contributed to the increase in parent knowledge and competence that both groups reported following treatment. The C-HOPE intervention utilized a supportive model, consisting of both group and individual sessions; group facilitators reported a positive therapeutic alliance (Kuravackel et al., 2018) in which parents actively participated in discussions with other group members. This openness during parent training sessions could have contributed to the increase in some of the parent treatment outcomes (i.e., knowledge, competence).

Treatment effects

Following treatment, a significant large effect was found for increased parent knowledge in urban participants. This is likely due to a lower amount of knowledge reported at baseline (based on the score on the PKQ) for the urban group. Results on parent knowledge for rural participants were not significant, but a large effect for increased knowledge was noted. No significant improvement was revealed for change in parent activation in both rural and urban participants, but a large effect was noted for both groups. Additionally, results showed a decrease in activation for the urban group, and increased in activation for the rural group; both were large effects, although there were minimal differences in the raw scores on the PAM measure. For change in parent competence, no significant changes were noted for either group, although there was a non-significant increase of parent competence in both groups, yielding a medium effect for rural participants and a small effect for urban participants. Lastly, change in overall outcomes was analyzed, revealing a strong significant negative correlation between increased parent competence and decreased child problem behaviors from pre- to post- treatment (Figure 1).

Correlational findings

The current study revealed a significant correlation, indicating a decrease in child behavior problems as parent competence increased from pre- to post-treatment. This outcome matches the results of the original COMPASS (Kuravackel et al., 2018) study, which also noted a decrease of child problem behaviors and an increase in parent competence. This suggests that intervention modalities are comparable across platforms (face-to-face versus technology) for both urban and rural groups. C-HOPE also examined the integration of web-based calls with parent-friendly sessions on behavior management techniques, similar to the OASIS program (Buzhardt & Heitzman-Powell, 2005; Heitzman-Powell et al., 2014). Both the OASIS and C-HOPE treatments revealed an increase of knowledge in parenting strategies and management skills. Particularly, the C-HOPE rural participants noted an increase in self-management techniques following treatment. However, OASIS used in-vivo coaching in addition to online training, which provided live feedback to parents, as they practiced strategies with their children with ASD. C-HOPE's format did not follow this approach, but may benefit from this addition in order to improve child behavior outcomes.

Limitations

The present study also includes some limitations. First, the sample size for this study (n = 20) was small, resulting in an exploratory data analysis of the pre- and post-treatment data and limited the options for other forms of analysis (i.e., a two-way ANOVA for comparisons, a statistical test to examine interaction effects, or a regression-based framework to examine the strength of the correlation analysis). Second, baseline data only included demographic information of ethnicity, parent years of education, income, number of services received, and number of parents in the home. There was not a specific variable for socioeconomic status (SES) to further compare the rural and urban groups. It would also be important to collect more detailed participant information at pre-treatment and during follow-up to note changes in outcome among rural and urban groups (i.e., behavioral changes in the child, changes in parent-perception). For example, it is possible that the there were differences between groups on other mediating factors (i.e., need for caregiver training and support, reliable internet access, types of behavior problems), which should be explicitly measured moving forward. Third, it is important to note that many of the measures used in the current study demonstrated a wide standard deviation (see Tables 3 and 4). Because the standard deviations were relative large compared to the means of the rural and urban groups, the data were spread out over a wider range of values. This is likely due to the small sample size of this study and the variation amongst participant data. Fourth, although this telehealth treatment appeared to be effective for some outcomes in rural and urban areas (i.e., parent activation, knowledge), it is important to assess whether a remote treatment is still able to foster participation and engagement in the group. According to anecdotal reports from the principle investigators and facilitators of the treatment groups as well as on the parent-reported satisfaction questionnaires, participants reported high group alliance and group participation during back and forth discussions (Kuravackel et al., 2018). Additionally, no concerns were noted in regards to confidentially, as the telehealth sessions occurred under a secure network at a school education center. Further, feasibility metrics were not included (i.e., acceptability, validity, appropriateness), which could strengthen the support of the telehealth delivery model across groups. Fifth, it is important to note that this study was conducted years prior to the COVID-19 pandemic and thus the use of video-based communication platforms (e.g., Zoom, Webex) were not yet widespread. Children in this study received in-person diagnostic assessments (regardless of group), and it is likely that families able to participate in research activities that require these in-person visits may differ from families who do not participate, particularly in areas where the burden of travel is higher. Future research on this treatment should include current advanced information and communication technology to provide alternative methods that can be delivered to rural or remote areas. This can include videoconferencing, mobile platforms, or other similar telehealth kits.

Future directions

Making services accessible can help bridge the gap between rural communities for children with ASD. However, the barriers in rural communities that may potentially limit telehealth implementation should also be noted. Families in rural areas may not have access to the Internet or the technology needed to implement telehealth services. Reaching out to areas with local community centers that have access to technology is central to telehealth services, especially when clients do not have technology at home. Keeping that in mind, security and privacy is also necessary to avoid any ethical issues. Families in rural populations live in a close-knit social community, and the cultural differences in terms of the mental health stigma and potential discomfort with outside professionals can be difficult when serving rural families. Taking this into consideration, in-home online treatment can be appealing to some of these families if it is accessible to them. They also may not be comfortable with or knowledgeable about certain technology, so including technology training in treatment will assure that both the client and provider are well versed in the approach that will be utilized. Showing respect and understanding of the community's strengths and barriers can lead to a strong therapeutic relationship and an increase in positive treatment outcomes (Antezana et al., 2017).

Future studies on the C-HOPE intervention, or any other telehealth-based treatments for parents of children with ASD, should promote generalization to larger, diverse populations, especially those living in underserved, rural, and/or low-income communities (West et al., 2016). Multiple factors should be considered to better tailor telehealth treatments to these remote populations. Social support should be assessed as a part of pre-treatment, in order to gain information on how the presence of a support system (or lack thereof) may impact treatment outcomes (Dunn et al., 2001; Luther et al., 2005).

Additionally, the present study collected data on services received prior to enrolling in C-HOPE, but collecting independent follow up data on the participants would further inform the effectiveness of the treatment and also provide information on other services or supports the participants sought after completing the study.

Implementation should also further assess the feasibility of the form of technology used for treatment, including how comparable it is to face-to-face treatment. More sophisticated technology methods should also be considered, such as in-vivo and instructional teleconferencing, smartphone applications or modules (similar to the OASIS modules), or ecological momentary assessments (EMA; Shiffman et al., 2008). The primary technology platform used in the C-HOPE intervention was video teleconferencing, which is a low-cost technology that allows providers and clients to communicate with each other. Buchter and Riggleman (2018) discussed the benefits of using teleconferencing to overcome the challenges of serving remote areas. This form of communication is an effective alternative to traveling, both for the families and the providers, and it increases productivity as it allows more families to gain access to services in a shorter amount of time. Additionally, the ability for the providers to videoconference live with the family and their child with ASD allows for service in a naturalistic setting without the provider possibly influencing outcomes in a way that may occur if they were actually in the home. Families are also able to use teleconferencing to access a variety of professionals with diverse training backgrounds that can cater to particular needs depending on the child with ASD, as evidenced by the transition to telehealth that has occurred over the course of the COVID-19 pandemic.

EMA (Shiffman et al., 2008) is also a viable approach to more intensive measures of behavior and well-being. This methodology involves participants completing ratings at various times throughout the day when prompted. By delivering assessments via phone messaging or websites, EMA can be administered relatively easily and quickly to parents or children who only have access to a cellular phone. The assessments can include current self-report measures of one's current mental state, in their natural environment (i.e., stress, mood). These frequent in-the-moment assessments offer many advantages, as it provides a unique perspective of the parents or child's experiences over time. By capturing momentary states that are often responses to certain events, EMA allows for the assessment of highly dynamic outcomes, which may vary on a day-to-day or hour-to-hour basis, demonstrating the trajectory and patterns of these outcomes. Incorporating the technology methods mentioned would allow for a streamlined assessment of treatment outcomes and provide easily accessible treatment options to families in remote areas that can be more affordable.

Conclusions

The current findings provide preliminary evidence that the telehealth delivery of C-HOPE can be effective in improving parent and child outcomes across both rural and urban populations. This study revealed some important differences between the two groups, with rural and urban groups having different levels of knowledge prior to treatment, and medium to large effect improvements in parental efficacy after treatment. Improvements in parental competence also were significantly related to improved child outcomes.

As previously discussed, rural and underserved areas are limited in access to health care, especially for children with ASD. Because of the barriers faced by both families and service providers in these areas, it is essential to adapt novel and efficient methods of service delivery, including technology-based approaches. Research has shown the success of teaching evidence-based behavioral strategies to parents of children with ASD (using programs such as PRT or COMPASS), noting positive outcomes in both parent competence and child behaviors (Bearss et al., 2015; Brookman-Frazee & Koegel, 2004; Rocha et al., 2007). Thus, parent-training interventions can be a sustainable option for rural, underserved areas. Similar to other parent-training models, C-HOPE focuses on parent education and skill development as the main treatment target. Increasing parent knowledge, competence, and mood, while decreasing stressors and negative behaviors in both children and parents, are all fundamental outcomes in many efficacious parent-training programs (R. L. Koegel et al., 1996; L. A. Ruble et al., 2013).

As such, the overall outcomes of this intervention are promising. Future dissemination and implementation of C-HOPE should consider the practical barriers of access to reliable information and communication technology in larger rural populations, as some platforms can be limited in remote or underserved areas.

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