Article

The TREE Program: Promoting Positive Early Childhood Experiences During Well-Child Visits

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Abstract

This feasibility study evaluated the developmental coaching TREE (Talk Read Engage Encourage) program for historically marginalized children ages 0 to 2 years, embedded within pediatric visits, examining if TREE could enhance caregiver-child interactions and increase pediatric resident report of competency and self-efficacy in coaching caregivers. Using a quasi-experimental design, a convenience sample (n = 167 families) was recruited (79 intervention; 88 control). Follow-up data were obtained from 45% of families (38 intervention; 38 control), impacted by COVID-19 attendance. Analyses demonstrated significant increases in self-reported Parent Verbal Responsivity (d = 0.68; 95% confidence interval [CI] = 0.17 to 1.18; P = .009) by intervention group caregivers. Intervention pediatric residents reported significant increases in promoting positive caregiver-child interactions and confidence in conveying child development (d = −.73; 95% CI = −1.21 to −0.22; P = .003). The TREE program is a promising practice that operationalizes promotion of relational health and positive early childhood experiences within pediatric primary care.

Keywords

relational health, positive early childhood experiences, positive parent-child relationships, marginalized children, pediatric primary care, pediatric residents, developmental coaching

Introduction

Adverse Childhood Experiences (ACEs) can fuel social, environmental, and ecobiodevelopmental stressors that effect child cognitive, social-emotional, and physical health outcomes.[1-4] Furthermore, ACEs, poverty, and racism complexly intersect as they independently and cumulatively impact developmental and health trajectories. These fragile interactions became particularly evident during the COVID-19 health crisis when prepandemic societal disadvantages and structural racism became central determinants of unequal health outcomes.[5,6]

Nine million children (12%) are living in poverty in the United States, with rates higher for black (18%) and Latino (20%) children.[7] Poverty is associated with delayed language skills,[8] decreased school readiness skills,[9] reduced high school graduation rates and increased behavioral problems,[10] and negative child health outcomes.[11] Poverty reflects a compilation of social determinants of health (SDOH) risk factors (eg, housing, food, safety, education, employment, racism) that negatively impact family and children.[12,13] The impact of systematic and structural racism, an SDOH

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component, also impacts child development through biological embedding and intergenerational transmission of risk factors that perpetuate disparities.[6] Black children are less likely than their white counterparts to be referred to early intervention (EI).[14] They have higher rates of school absenteeism, suspension, and expulsion, all of which negatively influence educational outcomes. The impact of racism has also been linked to birth disparities, childhood and adolescent mental health outcomes, and to chronic disease.[15] Pediatric practitioners can address childhood SDOH, including racism, through enhanced screening and community resource referrals.[12-17]

Preventive pediatric care that incorporates parent-child relational health, parent social support,[16] and early learning promotion is a critical aspect of addressing the needs of historically marginalized families.[17] Positive Early Childhood Experiences (PCEs), characterized as safe, stable, nurturing relationships, and environments, create resilience pathways[18] and can mitigate many of the deleterious effects of ACEs,[2,16,19-21] and PCEs can lead to improved adult mental and physical health outcomes.[18,22] Pediatric providers are called to identify implicit bias, create a culturally safe medical home, recognize the impacts of racism on children, intervene with appropriate community referrals,[23] and promote positive relational health.[16] Pediatric practitioners can play a key role in identifying family strengths that promote PCEs[24-26] and early relational health.[16]

Child development research suggests that talking,[27,28] reading,[29,30] and playing[31,32] with young, historically marginalized, children improves developmental outcomes. Responsive parenting through warm and accepting behaviors is also associated with improved developmental outcomes.[33] The Grow Your Kids: TREE (Talk Read Engage Encourage) program fosters resilience in families who are at risk for developmental delay due to SDOH by promoting PCEs and early relational health. Many children may be experiencing mild delays but may not qualify for statewide EI services.[34] TREE, a developmental coaching program developed by a state chapter American Academy of Pediatrics Emotional Health Committee, is delivered by pediatric providers during routine well-child care (WCC) visits of families with children ages 0 to 2 years. The TREE educational and parenting materials are freely accessible on the Maryland Chapter American Academy of Pediatrics (MDAAP) website.[35] The program is a strength-based approach that requires a paradigm shift from asking "What is wrong?" to "What is going well for your child?" The TREE program also shifts the pediatric provider and caregiver interaction from anticipatory guidance to "participatory guidance." Caregivers are engaged by asking open-ended, self-reflective questions such as "what *fun* things do you enjoy doing with your child?" The program uses a process-oriented developmental narrative (eg, motor skills proceed from head to toe) that is easy for caregivers to understand across the domains of communication and language, motor skills, cognitive thinking and learning, and social-emotional development.[36] This leads to a discussion of best practices on how to effectively talk, read, and play with young children currently, and how to adjust interactions as development progresses. The main concepts are further reinforced by QR code accessible online parent resource material in English and Spanish.

Several programs, such as Reach out and Read, Video Interaction Project (VIP), and Healthy Steps, have demonstrated effectiveness with families experiencing disadvantage. These include increasing visit attendance (Reach out and Read,[37] Healthy Steps),[38] satisfaction with pediatric providers (Healthy Steps),[39,40] improving parent-child interactions (Reach out[41] and Read, VIP),[42] parents positively relating to child development (VIP),[43,44] and decreasing behavior problems (Healthy Steps).[38] The FAN (Facilitating Attuned iNteractions) model has also increased relational empathy scores in pediatric residents.[45] The TREE differs from such programs as it provides a unique approach to promoting relational health by offering a brief and inexpensive intervention that is offered by the pediatric provider, does not require additional staff, is embedded within usual visits, and is not limited to distribution of materials. Whereas developmental surveillance and screening have long been primary pediatric practices to identify and refer children in need,[46] interventions like the TREE program extend beyond surveillance and screening to also promote a universal first line relational health intervention. This aligns with AAP advocacy and can potentially help offset the deleterious impact of ACEs and developmental gap in children facing disadvantages.

During a prior pilot study at a single site focused on trainee acceptability of TREE, 68% of trained residents at an urban hospital serving primarily Medicaid recipients were highly or extremely satisfied with TREE. Results showed significant increases in the amount pediatric providers discussed development and parenting during visits, documented discussion of parent-child interactions, and reported confidence in discussing development and parenting. However, 68% reported the largest implementation barrier was time constraints during well-child visits.[47] Subsequently, this study was designed to evaluate the impact of the program on caregiver behaviors and to continue to explore pediatric residents' self-efficacy in promoting positive caregiver-child interactions and PCEs. The time barrier was partially

addressed by having full implementation supported by all clinic staff, providing enough toys for each room, including protocols to help with cleaning of toys, and integrating TREE into the electronic medical record (EMR) system so that it was part of the well-child visit and not as an added activity.

This article focuses on the outcomes of a quasi-experimental feasibility trial of the TREE program in 2 pediatric residency programs in a single city, 1 of which served as the intervention site. This study was initiated with limited, local foundation funding. The intention was to establish initial evidence before proceeding with a full trial. The CONSORT 2010 checklists for pilot or feasibility studies were used as a guide.[48]

This study examines feasibility of TREE implementation via 3 research questions: (1) Does TREE lead to caregiver behavior change when compared to controls? (2) Does TREE lead to changes in pediatric resident behavior and confidence compared to controls? and (3) Can implementation fidelity be maintained within busy pediatric resident trainee practices? First, we hypothesized that the intervention caregiver group compared to the control group would report significantly greater talking, reading, engaging with, and encouragement of their young children. Second, we expected that TREE-trained pediatric residents would report significantly greater perceived competency and self-efficacy in promoting positive caregiver-child interactions compared to those not trained. The third aim was to examine if implementation of the TREE intervention could be maintained over time as determined by practice documentation.

Methods

This quasi-experimental, wait-list control group feasibility study took place in the outpatient primary care practices associated with 2 pediatric training programs in a mid-sized city. These sites serve comparable populations. One site served as the intervention site and the other as the control site. Randomization of pediatric residents within each site was not logistically possible. The Institutional Review Board (IRB) approval was obtained for both institutions (HP-00083183).

Enrollment

Caregivers. Caregiver inclusion criteria (Figure 1) were any interested English speaking primary caregivers (eg, mother, father, legal guardian) over age 18 years of age with children ages 4 to 9 months presenting for WCC visits. Recruitment took place May through August (intervention, 79 caregivers) and August through November (control, 88 caregivers) of 2019. Caregivers were approached in the waiting room by clinic staff or study interviewers and given a brief overview of the study. If they agreed to participate, written informed consent was obtained by study interviewers. Participants were not informed of intervention or control group status. Participants chose to complete baseline questionnaires via paper-and-pencil or tablet computer with the interviewer present. As an incentive, families selected a non-toy item (eg, feeding and bath supplies) for intake questionnaire completion. Follow-up data were collected April through December (intervention) and May through December (control) of 2020. The original intention was for families to have completed at least 3 WCCs (6, 9, 12, 15, or 18 months) to experience TREE before follow-up data collection. Due to COVID-19 restrictions, follow-up data were collected virtually via IRB-approved secure electronic links. Caregivers were contacted by phone, email, or text to re-engage and sent electronic gift cards upon questionnaire completion.

Pediatric Residents. Clinic directors and attendings (Figure 2) recruited all categorical pediatric residents at intervention (n = 24) and control (n = 42) sites. Consent was obtained as a group or individually during precepting.

Talk Read Engage Encourage Intervention Training and Implementation

Two study authors trained all the intervention site pediatric residents in TREE during two 20-minute training sessions, delivered 4 weeks apart. Trainers remained available for ongoing consultation, and free TREE teaching written and video materials were available.[49] TREE was implemented during the 4-month through 24-month WCC visits by all of the intervention site pediatric residents and documented in the EMR. Pediatric residents were prompted in the EMR to document fidelity to TREE activities during WCC visits. Providing positive feedback to caregivers is also an essential TREE component and was documented in the EMR as well.

Measures

Caregiver Demographics and Caregiver-Child Interaction. Caregivers completed a demographic questionnaire. The STIMQ2,[49] an update of the StimQ,[50,51] is a structured parent measure designed to assess caregiver-child interactions at home. The STIMQ2 asks caregivers about their specific learning materials (eg, toys and books) and behaviors (eg, playing and reading). This measure has demonstrated reliability and validity with

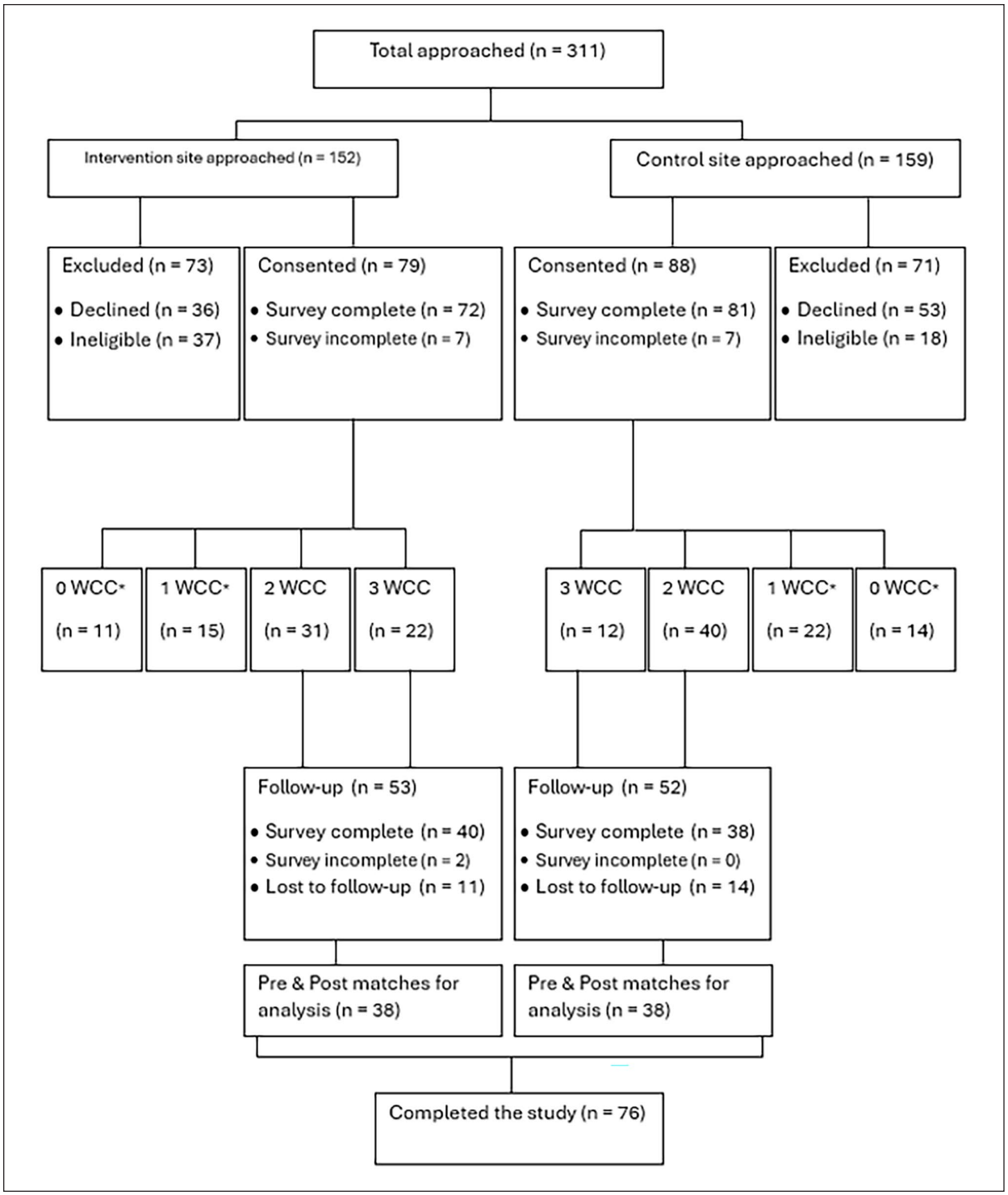

Figure 1. Caregiver consort diagram.

low-income populations.[50,51] Baseline and follow-up STIMQ2s (Infant and Toddler versions, respectively) were administered to each caregiver group. There are 4 STIMQ2 scales with corresponding subdimensions: Reading (subdimensions Quantity, Diversity, Quality), Parental Involvement in Developmental Advance (PIDA), Parental Verbal Responsivity (PVR; subdimensions Everyday Routines, and Play and Pretend), and

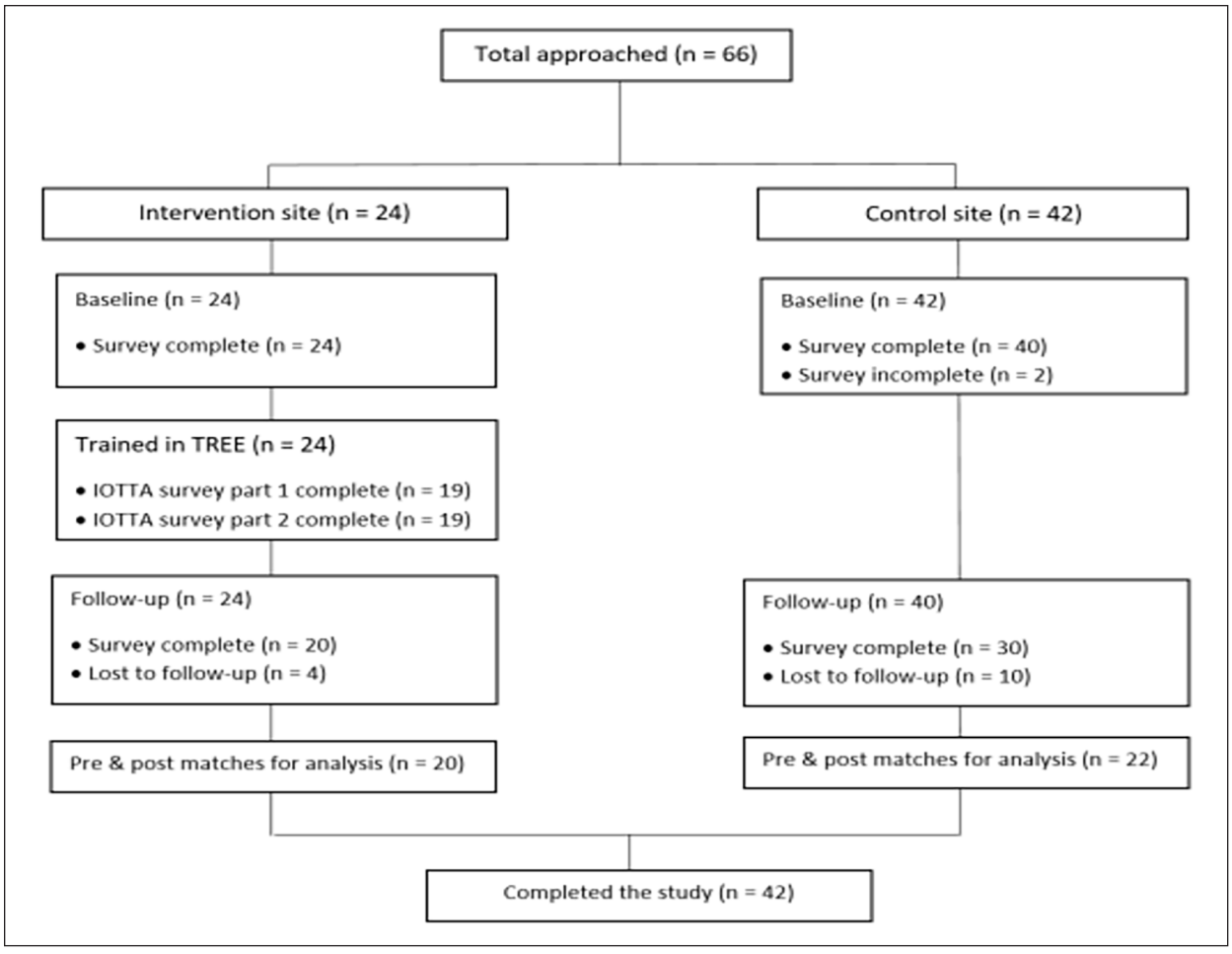

Figure 2. Pediatric provider consort diagram.

Availability of Learning Materials (ALM). Scales consist of the summed subdimension scores. Reading, PIDA, and PVR scale scores combine creating the STIMQ2 total score. The ALM is a standalone subdimension and is not included in the total STIMQ2 score. The ALM items in the infant version (baseline) and toddler version (follow-up) are substantially different and therefore were not included in analyses. Parents completed the STIMQ2 independently; it was administered in interview format (7 caregivers) per parent request.

Pediatric Residents Demographics and Pediatric Residents Assessment of Training. Residents completed a demographic questionnaire. The Impact of Training and Technical Assistance (IOTTA) was administered only to intervention residents immediately following and 3 months post-TREE training to assess impact of training. The IOTTA is a standardized implementation science measure that assesses training domains (eg, mastery of content, usefulness, trainer credibility) and changes in practice over time.[52]

Pediatric Residents Competency and Self-Efficacy With TREE. The TREE Provider Questionnaire, designed by the TREE program developers, measures provider competency and self-efficacy in promoting positive caregiver-child interactions. It is comprised of ten 5-point Likert scale (never to always), self-report items that ask providers about their comfort with and confidence in discussing and promoting child development and parenting within WCC visits. A total score is created by summing all the items. The TREE questionnaire was trialed in earlier work on acceptance of the program by pediatric residents at 2 training programs. It was designed to obtain resident feedback in concert with the TREE relational health learning objectives. Both intervention and control residents completed the questionnaire at baseline and follow-up to allow for between-group and within-group comparison.

EMR Abstraction and Intervention Site. The TREE implementation fidelity was tracked via EMR documentation for all WCCs for study participants.

Providers documented if TREE was implemented and which components were implemented. The EMR data were extracted from the EMR by trained research assistants. Documented TREE components included TREE and developmental concepts shared, discussion of current and future activities planned with the child, and TREE activities directly observed.

Analysis Plan

Demographic data were analyzed using descriptive analyses and independent samples *t*-tests to test for group differences. The potential effectiveness of the program was explored using different tests, with the results expressed using descriptive statistics and effect estimates (95% confidence intervals) consistent with feasibility study approaches.[53] For caregiver and provider outcomes, analyses were conducted in 3 steps (Baseline, Within-Group, and Between-Group Change Scores): (1) baseline between-groups independent samples *t*-tests were used to identify group differences prior to intervention; (2) pre/post-paired-sample *t*-tests were planned to examine within-group changes over time; and (3) between-group change scores were compared to detect group differences in change over time using independent samples *t*-tests.

Results

Caregivers

Caregiver demographics. Recruited children were aged 3 to 11 months old (both sites), predominantly black (76% intervention; 77% control), and on Medicaid (81% intervention; 78% control). At baseline, caregivers were largely between ages 21 and 30 years (48% intervention; 58% control), employed full-or-part-time (47% intervention; 54% control), and either single or divorced/separated (53% intervention; 54% control; see Table 1). Results of independent samples *t*-tests across race, insurance coverage, employment, education, and marital status indicated no significant baseline demographic differences between intervention and control caregivers. As seen in Table 1, cell sizes were under 10 for many variables (eg, levels of education and marital status) so further analyses to verify no significant group differences were not conducted.

Baseline to follow-up timelines. Due to COVID-19-related challenges, follow-up data for the control group were collected earlier than originally planned. Rather than collecting data for the follow-up group starting 3 months later, we started one month later. However, this did not have a large impact on the outcomes. Demographic data indicate the mean age and age range was the same or similar for both groups at baseline ($M_{Intervention}$ and $M_{Control}$ = 6, Range $M_{Intervention}$ = 4-10; $M_{Control}$ = 3-11) and remained same or similar at follow-up ($M_{Intervention}$ = 18 and $M_{Control}$ = 17, range $M_{Intervention}$ and $M_{Control}$ = 15-23; see Table 1). As data collection was variable in both groups and there was overlap in baseline data collection (August of 2019), this slight change in the timeline did not seem to create a large difference in the average age of children at follow-up.

Caregiver-child interactions. Follow-up data collection was impeded by decreased attendance and safety protocol related to the COVID-19 pandemic. There were 53 intervention caregivers and 52 control caregivers who completed follow-up questionnaires. However, due to incomplete data or a lack of WCC visits attended, only 38 match-pairs were included in the final analyses for both groups (see consort diagram in Figure 1).

Baseline. At baseline, the control site had significantly higher STIMQ2 total infant score (18.14 vs 14.16, $P = .03$). The PVR scale (9.91 vs 6.97, $P = .001$) was also higher for control site participants as were the subdimensions PVR Everyday Routines (5.24 vs 3.5, $P = .001$) and PVR Play and Pretend (3.37 vs 2.21, $P = .02$).

Within-groups. The intervention group in comparison to the control group demonstrated significant positive changes over time in the StimQ PVR total, PVR Everyday Routines, and PVR Play/Pretend (all $P < .05$; see Table 2). The Parent Verbal Responsivity items ask questions such as "Do you talk to your child while doing chores/ housework?" and "Do you play pretend games using a stuffed animal or puppet to talk to your child?" In addition, the READ Quality ($t = -1.85$; $P = .07$) scale was noted to be trending toward significance. Both groups displayed significant positive behavioral increases in the remaining subscales.

Change scores between groups. Change scores were created by subtracting prescores from postscores. Significant and trending findings are shown in Figures 3–6. The intervention group, compared to control, demonstrated significantly greater improvement in the PVR scale score ($t = 2.71$; $d = 0.68$; 95% confidence interval [CI] = 0.17 to 1.18; $P = .009$; Figure 3). There were also trends for the STIMQ2 Total ($t = 1.84$; $d = 0.43$; 95% CI = 0.04 to 0.89; $P = .07$; Figure 4), PVR Everyday Routines ($t = 1.88$; $d = 0.43$; 95% CI = −0.03 to 0.88; $P = .07$: Figure 5), and PVR During Play and Pretend Play ($t = 1.71$; $d = 0.39$; 95% CI = −0.06 to 0.85; $P = .09$; Figure 6). As a feasibility study, consideration of trends and effect sizes is warranted for planning of future efficacy study design.[54] There were

Table 1. Caregiver and Child Demographics.

	Baseline			Follow-up		
	Intervention (n = 79)	Control (n = 88)	Total (n = 167)	Intervention (n = 42)	Control (n = 38)	Total (n = 80)
Child gender						
Male	42 (53%)	43 (49%)	86 (51%)	23 (55%)	21 (55%)	44 (55%)
Female	33 (42%)	41 (47%)	74 (44%)	19 (45%)	16 (42%)	35 (44%)
Missing	4 (5%)	4 (5%)	4 (5%)	-	1 (3%)	1 (1%)
Mean child age (range)	6 mo. (4-10 mo.)	6 mo. (3-11 mo.)	6 mo. (3-11 mo.)	18 mo. (15-23 mo.)	17 mo. (15-23 mo.)	18 mo. (15-23 mo.)
Medicaid recipient	64 (81%)	69 (78%)	133 (80%)	39 (93%)	30 (79%)	69 (86%)
Child race						
Black	60 (76%)	68 (77%)	128 (77%)	37 (88%)	30 (79%)	67 (84%)
Asian	2 (3%)	1 (1%)	3 (2%)	2 (5%)	1 (3%)	3 (2%)
White	3 (3.80%)	3 (3%)	6 (4%)	1 (2%)	3 (8%)	4 (2%)
Latino	2 (2.50%)	1 (1%)	3 (2%)	-	-	-
Multiracial	4 (5.10%)	5 (6%)	9 (5%)	1 (2%)	4 (11%)	5 (6%)
Missing	8 (10.10%)	10 (11%)	18 (11%)	1 (2%)	-	1 (1%)
Respondent						
Birth mother	68 (86%)	73 (83%)	141 (84%)	38 (91%)	35 (92%)	73 (91%)
Birth father	4 (5%)	8 (9%)	12 (7%)	2 (5%)	2 (5%)	4 (5%)
Foster parent	2 (3%)	-	2 (1%)	2 (5%)	-	2 (3%)
Grandparent	1 (1%)	1 (1%)	2 (1%)	-	1 (3%)	1 (1%)
Other	-	1 (1%)	1 (1%)	-	-	-
Missing	4 (5%)	5 (6%)	2 (5%)	-	-	-
Caregiver age						
≤20 years	7 (9%)	4 (5%)	11 (7%)	2 (5%)	-	2 (3%)
21-30 years	38 (48%)	51 (58%)	89 (53%)	18 (43%)	18 (47%)	36 (45%)
31-40 years	24 (30%)	17 (19%)	41 (25%)	16 (38%)	13 (34%)	29 (36%)
41-50 years	3 (4%)	2 (2%)	5 (3%)	2 (5%)	-	2 (3%)
>50 years	1 (1%)	2 (2%)	3 (2%)	1 (2%)	2 (5%)	3 (4%)
Missing	6 (8%)	12 (14%)	18 (11%)	3 (7%)	5 (13%)	8 (10%)
Employment						
Full-time	23 (29%)	38 (43%)	61 (37%)	16 (38%)	17 (45%)	33 (41%)
Part-time	14 (18%)	10 (11%)	24 (14%)	6 (14%)	3 (8%)	9 (11%)
Occasional Unemployed	37 (46%)	33 (38%)	70 (42%)	19 (45%)	18 (47%)	37 (46%)
Missing	5 (6%)	7 (8%)	12 (7%)	1 (2%)	-	1 (1%)
Education						
<12th grade	6 (8%)	3 (3%)	9 (5%)	-	1 (3%)	1 (1%)
HS VOC/TECH	33 (42%)	39 (44%)	71 (43%)	10 (24%)	19 (50%)	26 (33%)
Some college	23 (29%)	23 (26%)	46 (28%)	20 (48%)	6 (16%)	26 (33%)
≥BA	7 (9%)	15 (17%)	22 (13%)	3 (7%)	7 (18%)	10 (13%)
Missing	11 (14%)	8 (9%)	19 (11%)	9 (21%)	5 (13%)	1 (1%)
Marital status						
Single	41 (52%)	47 (53%)	88 (53%)	17 (41%)	23 (61%)	40 (50%)
Married	14 (18%)	15 (17%)	29 (17%)	9 (21%)	9 (24%)	18 (23%)
Living with partner	17 (22%)	17 (19%)	34 (20%)	13 (31%)	6 (16%)	19 (24%)
Divorced/separated	1 (1%)	1 (1%)	2 (1%)	2 (5%)	-	2 (3%)
Missing	6 (8%)	8 (9%)	14 (8%)	1 (2%)	-	1 (1%)

no significant differences noted between groups on the other scales (see Table 3 for all STIMQ2 findings).

It is worth noting that the intervention scores experienced significant positive changes over time and significantly greater positive changes scores in the same dimensions in which the control group had higher baseline scores—PVR total, PVR Everyday Routines and PVR During Play, and Pretend Play. Hence, the

Table 2. Within-Group StimQ Scores for Intervention and Control Groups.

Variable	n	Baseline M (SD)	Follow-up M (SD)	*t*	*P*	Cohen's *d* (95% CI)
StimQ total						
Intervention	37	14.46 (7.99)	24.0 (8.46)	-6.56	<.001*	-1.08 (-1.48 to -0.67)
Control	36	18.14 (7.6)	24.11 (9.04)	-4.65	<.001*	-0.78 (-1.14 to -0.40)
READ						
Intervention	33	7.82 (2.87)	12.06 (3.87)	-6.23	<.001*	-1.08 (-1.51 to -0.65)
Control	29	8.72 (3.17)	12.79 (3.32)	-6.65	<.001*	-1.24 (-1.72 to -0.74)
READ quantity						
Intervention	32	4.06 (1.7)	5.19 (2.13)	-4.45	<.001*	-1.18 (-1.18 to -0.38)
Control	29	4.17 (2.14)	5.66 (2.18)	-4.33	<.001*	-0.79 (-1.22 to -0.38)
READ diversity						
Intervention	31	1.58 (0.5)	4.45 (1.09)	-14.3	<.001*	-2.57 (-3.3 to -1.83)
Control	29	1.69 (0.54)	4.41 (1.24)	-11.47	<.001*	-2.13 (-2.79 to -1.46)
READ quality						
Intervention	30	2.3 (1.37)	2.8 (1.16)	-1.85	.07^	-0.34 (-0.70 to 0.03)
Control	29	2.86 (1.41)	2.72 (1.22)	.416	.68	-0.08 (-0.29 to 0.44)
PIDA						
Intervention	25	2.4 (1.12)	3.12 (1.39)	-2.47	.02*	-0.49 (-0.91 to -0.07)
Control	25	2.72 (1.06)	3.64 (1.08)	-3.19	.004*	-0.63 (-1.06 to -0.20)
PVR						
Intervention	31	6.97 (4.55)	9.84 (4.36)	-3.02	.005*	-0.54 (-0.92 to -0.16)
Control	33	9.91 (2.63)	9.67 (3.87)	.365	.72	-0.18 (-0.28 to 0.41)
PVR routines						
Intervention	38	3.5 (3.09)	5.55 (3.14)	-3.28	.002*	-0.53 (-0.87 to -0.19)
Control	38	5.24 (2.93)	5.79 (2.66)	-1.11	.27	-0.18 (-0.50 to 0.14)
PVR play/pretend						
Intervention	38	2.21 (2.08)	3.44 (2.11)	-3.33	.002*	-0.54 (-0.88 to -0.20)
Control	38	3.37 (2.14)	3.63 (1.79)	-0.61	.55	-0.10 (-0.42 to 0.22)

Abbreviations: PIDA, parental involvement in developmental advance; PVR, parental verbal responsivity.
^$P < .10$; *$P < .05$.

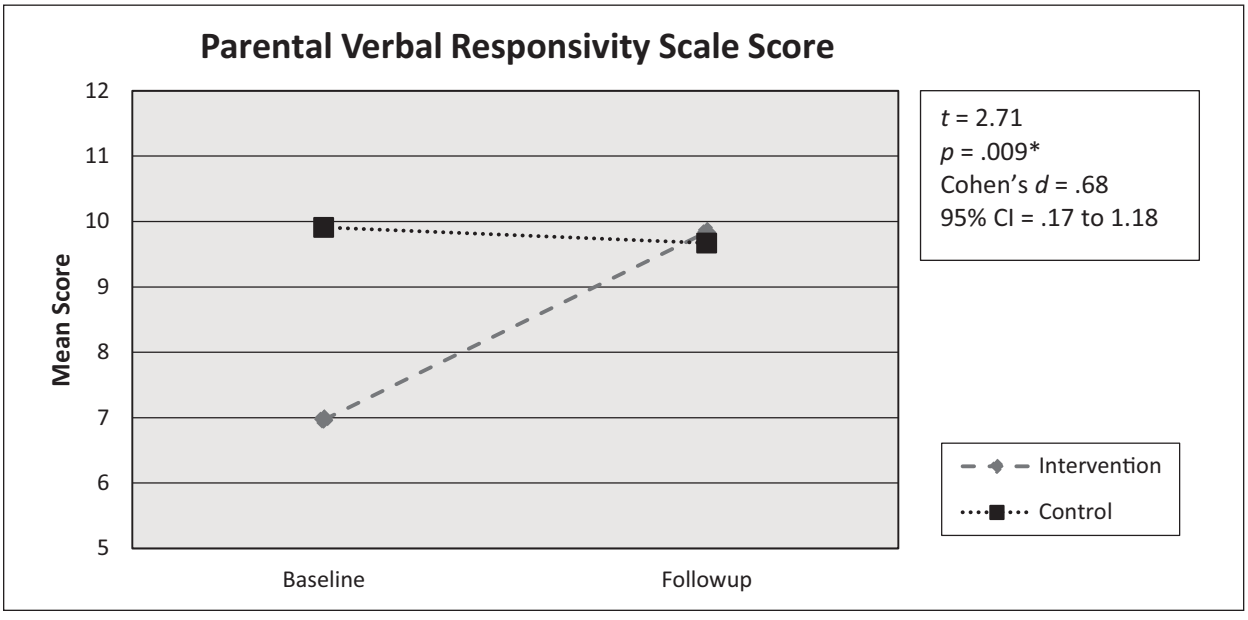

Figure 3. PVR scale score between intervention and control groups.

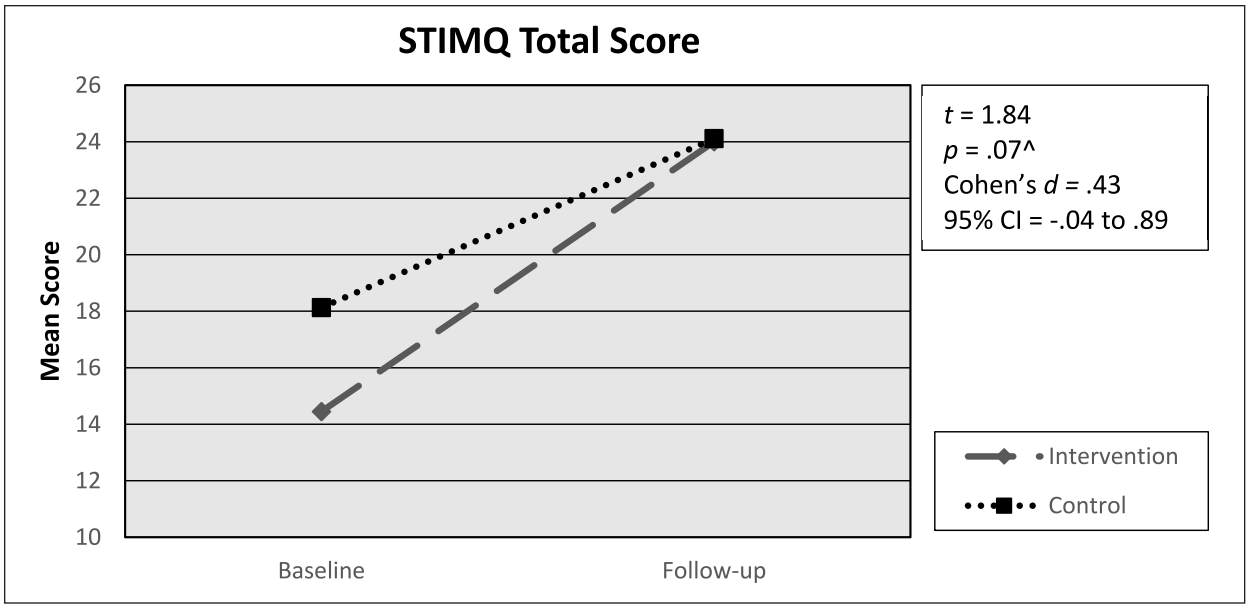

Figure 4. STIMQ Total Score between Intervention and Control groups.

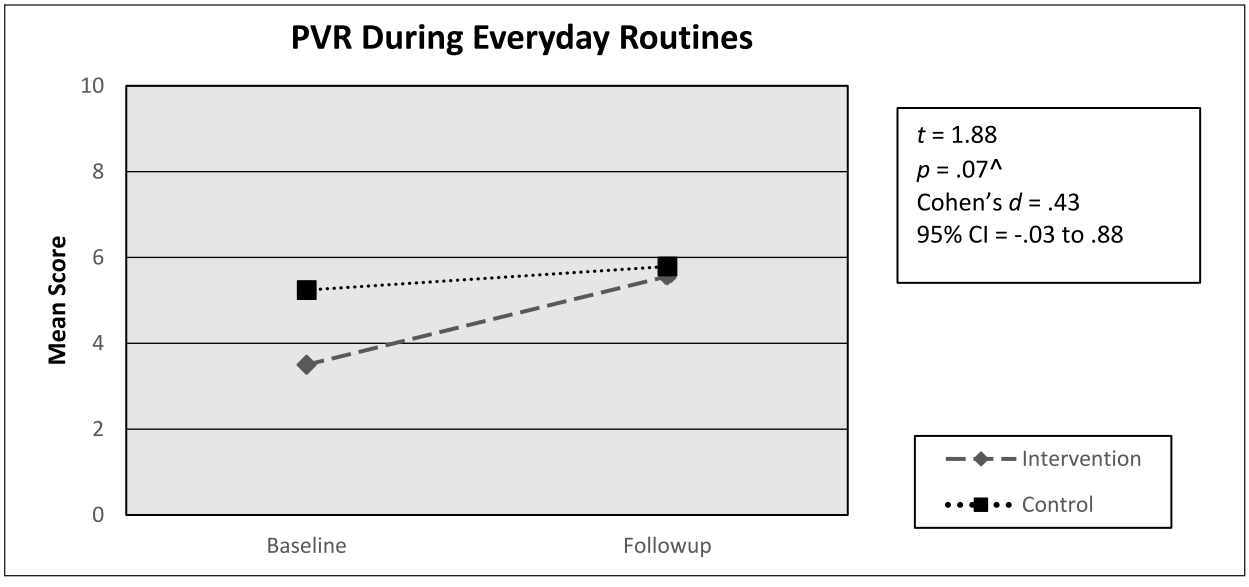

Figure 5. PVR during everyday routines between intervention and control groups.

intervention group seems to have experienced changes in the same areas that were identified as being lower than control at baseline.

Pediatric Residents

Pediatric residents' demographics. Intervention (24 baseline; 20 follow-up) and control (42 baseline; 30 follow-up surveys completed and 22 matched for analysis) residents engaged in data collection. Most residents were female (80% intervention; 89% control) and were not parents (90% for each). Internal analysis at the intervention site demonstrated 80% rate of continuity of care with the same resident.

Pediatric residents' assessment of training. On the IOTTA, intervention residents rated trainer credibility highly (mean [M] = 9.05 out of 11; standard deviation [SD] = 1.08) and reported their sense of mastery of the content increased from $M_{baseline}$ = 4.37 (SD = 2.09) to $M_{follow\text{-}up}$

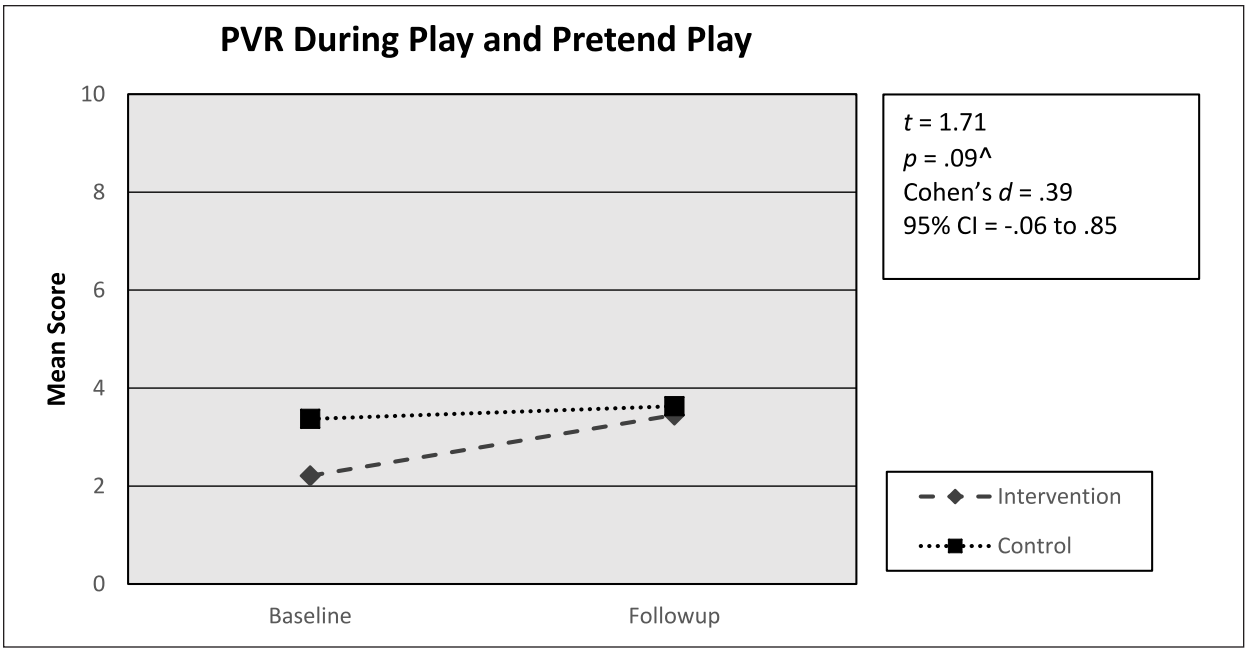

Figure 6. PVR during play and pretend play between intervention and control groups.

Table 3. Differences in Caregiver STIMQ2 Change Scores Between Intervention and Control Groups.

Variable	n	M (SD)	*t*	*P*	Cohen's *d* (95% CI)
StimQ total			1.84	.07^	0.43 (-0.04 to 0.89)
Intervention	37	9.54 (8.85)			
Control	36	5.97 (7.70)			
READ			0.19	.85	0.05 (-0.45 to 0.55)
Intervention	33	4.24 (3.91)			
Control	29	4.07 (3.29)			
READ.A			-0.85	.4	-0.22 (-0.72 to 0.29)
Intervention	32	1.13 (1.43)			
Control					
READ.B			0.47	.64	0.12 (-0.39 to 0.63)
Intervention	31	2.87 (1.12)			
Control	29	2.72 (1.28)			
READ.C			1.5	.14	0.39 (-0.13 to 0.90)
Intervention	30	0.50 (1.48)			
Control	29	-0.14 (1.78)			
PIDA			-0.49	.63	-0.14 (-0.69 to 0.41)
Intervention	25	0.72 (1.16)			
Control	25	.92 (1.44)			
Parental verbal responsivity (PVR)					
Intervention	31	2.87 (5.30)	2.71	.009*	0.68 (0.17 to 1.18)
Control	33	-0.24 (3.82)			
PVR.A					
Intervention	38	2.05 (3.86)	1.88	.07^	0.43 (-0.03 to 0.88)
Control	38	0.55 (3.06)			
PVR.B					
Intervention	38	1.24 (2.28)	1.71	.09^	0.39 (-0.06 to 0.85)
Control	38	0.26 (2.65)			

^$P < .10$; *$P < .05$.

= 7.16 (SD = 1.17; out of 11). Residents endorsed the training impacted the way they address families' needs (M = 1.37, SD = 0.90), interact with families (M = 1.58, SD = 1.07), and how they document their work with families (M = 1.11, SD = 1.10 on a scale of −3 to 3). Residents' IOTTA scores remained similar when assessed at the 12-week follow-up.

Pediatric residents' competency and self-efficacy

Baseline. At baseline, *Discuss with parents the importance of reading to infants/toddlers* ($P = .03$) was significantly greater for the intervention group than the control group (intervention group M = 3.95 [SD = 0.69] vs control M = 3.45 [SD = 1.19]).

Within-groups. Paired samples *t*-tests indicated that there were significant within-group self-reported improvements from baseline to follow-up on several items for intervention residents. These included promotion of *talking to infants/toddlers* ($t = -4.67$; $P < .001$), *reading to infants/toddlers* ($t = -4.98$; $P < .001$), *playing with infants/toddlers* ($t = -2.57$; $P = .02$), *being positive and encouraging* ($t = -2.45$; $P = .02$), *conveying child development* ($t = -3.25$; $P = .004$), *providing positive feedback* ($t = -2.35$; $P = .03$), and *satisfaction with WCC visits* ($t = -2.33$; $P = .03$). In contrast, the control group did not demonstrate significant changes on these items.

Control residents demonstrated statistically significant decrease over time for *fostering positive interactions* ($t = 2.16$; $P = .04$), but an increase in addressing *psychosocial issues* ($t = -3.18$; $P = .005$).

Change scores between groups. Intervention residents (see Table 4) demonstrated significantly greater improvement than the control group in the following items: promotion of *talking to infants/toddlers* ($t = 2.71$; $d = 0.84$; 95% CI = 0.20 to 1.47; $P = .01$), *reading to infants/toddlers* ($t = 2.32$; $d = 0.73$; 95% CI = 0.09 to 1.36; $P = 0.03$), *being positive and encouraging* ($t = 2.92$; $d = 0.90$; 95% CI = 0.26 to 1.53; $P = 0.006$), *fostering positive interactions* ($t = 2.56$; $d = 0.77$; 95% CI = 0.14 to 1.14; $P = 0.02$), and *conveying child development* ($t = 2.94$; $d = 0.91$; 95% CI = 0.27 to 1.54; $P = 0.005$, see Table 4). There was also a trend for *providing positive feedback* ($t = 1.71$; $d = 0.53$; 95% CI = −0.09 to 1.14; $P = .09$). There were no significant differences between intervention and control for the remaining items. Intervention residents improved Total TREE scores by an average of 4.35 points, compared to a loss of 0.14 points for control residents ($t = 2.96$; $d = 0.92$; 95% CI = 0.27 to 1.55; $P = .005$).

EMR Abstraction

A total of 279 medical records were abstracted for TREE activities conducted within intervention WCC visits. Extracted data were reviewed to determine whether TREE activities were implemented. Implementation was calculated by counting how many of the expected WCCs had TREE documentation in the EMR. Data indicated that there was TREE documentation for 74% of the first WCCs and 73% of the second visits. In contrast, TREE documentation was only present for 29% of third visits suggesting TREE practices decreased after 2 WCCs.

Discussion

This feasibility study examined the short-term impact of the TREE program on reported caregiver-child interactions in families with young children who are experiencing negative SDOH and pediatric residents' perceptions of promoting PCEs.

Caregiver-Child Interactions

Caregiver-child interactions as measured by the STIMQ2 showed significant increases in Parental Verbal Responsivity during daily routines (eg, feeding, chores) and play (eg, playing pretend games) *within* the intervention group. In addition, PVR baseline scores were significantly greater for the control group. Thus, the significant PVR differences in change over time between groups reflect a significant improvement in parental verbal interactions during routine activities and play for intervention families and virtually no improvement for control families. These results are not surprising as the PVR items are closely aligned with TREE content such as engaging children during routines. It is possible that the TREE intervention allowed for catch-up growth in parental responsivity skills. These feasibility results suggest that TREE positively impacts caregiver-child interactions within the confines of our caregiver sampling.

There are several trending findings worth noting *between* the intervention and control caregiver groups including increased scores in the intervention group Total STIMQ2 score and the PVR During Everyday Routines and PVR during Play and Pretend scales. This further suggests that TREE positively impacts parent verbal responsivity. However, further efficacy research is warranted to explore this more fully.

The TREE program did not impact all measured categories caregiver-child interactions on the STIMQ2. Parental Involvement in Developmental Advance which addresses use of toys in the home was not significantly different between the 2 caregiver groups. The TREE

Table 4. Differences in Pediatric Provider TREE Survey Change Scores Between Intervention and Control Groups.

Variable	n	M (SD)	*t*	*P*	Cohen's *d* (95% CI)
Talking to infants/toddlers			2.71	.01*	0.84 (0.20 to 1.47)
Intervention	20	0.80 (0.77)			
Control	22	-0.09 (1.27)			
Reading to infants/toddlers			2.32	.03*	0.73 (0.09 to 1.36)
Intervention	19	0.58 (0.51)			
Control	22	0.00 (0.98)			
Playing with infants/toddlers			1.68	.10	0.52 (-0.10 to 1.13)
Intervention	20	0.60 (1.04)			
Control	22	0.05 (1.09)			
Being positive/encouraging			2.92	.006*	0.90 (0.26 to 1.53)
Intervention	20	0.60 (1.10)			
Control	22	-0.32 (0.95)			
Foster positive interactions			2.56	.02*	0.77 (0.14 to 1.40)
Intervention	20	0.15 (0.49)			
Control	22	-0.36 (0.79)			
Facilitating change in interactions			1.01	.32	0.31 (-0.30 to .92)
Intervention	20	0.30 (0.73)			
Control	22	0.09 (0.61)			
Conveying child development			2.94	.005*	0.91 (0.27 to 1.54)
Intervention	20	0.50 (0.69)			
Control	22	-0.14 (0.71)			
Providing positive feedback			1.71	.09^	0.53 (-0.09 to 1.14)
Intervention	20	0.30 (0.57)			
Control	22	-0.05 (0.72)			
Addressing psychosocial issues			-0.23	.82	-0.07 (-0.68 to .54)
Intervention	20	0.40 (0.89)			
Control	22	0.45 (0.67)			
Satisfaction with well-child visits			0.53	.60	0.16 (-0.44 to .77)
Intervention	20	0.35 (0.67)			
Control	22	0.22 (0.81)			
Total TREE Survey score			2.96	.005*	0.92 (0.27 to 1.55)
Intervention	20	4.35 (4.23)			
Control	22	-0.14 (5.43)			

^$P < .10$; *$P < .05$.

intervention initially incorporated the modeling of developmentally appropriate toys during WCC visits, but COVID-19 pandemic procedures prevented this by disallowing the use of toys during visits, possibly explaining why specific play endorsement in the PIDA scale by parents was not significantly different between the 2 caregiver groups.

Reading subdimension change scores were also not significantly different between groups. Both practices are Reach Out and Read sites that routinely promote reading and provide books. The data revealed a trend in enhanced book reading quality within the intervention group, but the TREE program did not appear to have a significant additional impact on reading behavior with the intervention group overall when compared to the control group. However, these results could indicate that TREE has an impact beyond the reading behavior targeted through Reach Out and Read. This should also be explored more fully in future studies.

Pediatric Residents Assessment of Training

The IOTTA scores show that the training was impactful to residents both immediately after training and 3 months later. At both time points, pediatric residents reported a mastery of the contact, a positive impact of the training on the way they address families' needs, how they interact with families, and how they document their work with their families. This measure does not fully assess sustained implementation but indicates the initial training was well received and led to providers reporting positive practice changes.

Pediatric Residents Competency and Self-Efficacy

Intervention pediatric residents rated TREE training positively, endorsing improved practices, such as increased confidence in holding discussions with caregivers regarding the importance of talking, reading, and playing with infants/toddlers, discussing being positive and encouraging with infants/toddlers, conveying child development to caregivers, and providing positive feedback during visits. This suggests TREE had a positive impact on pediatric resident behavior and perceptions during WCC as expected and supports feasibility with residents. Positive responses to TREE implementation also indicate trainee acceptability. Control providers saw significant increases in addressing psychosocial issues, but they demonstrated significant decreases in fostering positive interactions over time. As fostering positive parent-child interactions is a primary intention of the TREE, this finding is particularly notable.

Other developmental coaching programs have noted positive clinician outcomes and feedback. These include the Keystones of Development online curriculum for pediatric residents, which showed significant increase in behaviors that promote positive parenting and resident self-efficacy,[55] increased relational empathy scores in pediatric residents trained in the FAN (Facilitating Attuned Interactions) model,[45] as well as Reach Out and Read, which has been associated with increased practice satisfaction among practitioners.[56] Thus, models such as this one have previously demonstrated positive impact on providers. Similar to our study, these studies also did not randomize resident groups.

EMR Abstraction

The TREE EMR documentation declined over time suggesting implementation maintenance may be challenging. It is unclear if this reflects a decrease in true TREE implementation, in EMR documentation, or both. The COVID-19 pandemic disrupted in-person WCC visits, potentially altering documentation. Additional implementation activities could include ongoing reminders by pediatric faculty and booster session case presentations addressing developmental coaching. Future TREE studies should further examine additional implementation support activities.

Limitations

COVID-19 disruptions posed significant challenges in TREE implementation and data collection. Appointment cancelations led to fewer families completing 2 to 3 WCC visits during the study timeframe, limiting the full impact of the program. Virtual data collection challenges reduced successful follow-up data collection. Despite these disruptions, we were able to achieve 48% and 43% retention for analyses in the intervention and control groups, respectively.

Several potential biases exist in the study. Intervention residents may have reported more positive perceptions knowing they were part of a study. There was also a larger drop out of pediatric residents in the control group who did not complete follow-up questionnaires which may have introduced uncertain sampling bias.

Caregiver self-report is a limiting factor. The STIMQ has demonstrated reliability and validity with populations facing poverty,[50,51] but it is typically administered in interview format. In addition, families who completed follow-up questionnaires were possibly more resourced compared to families who were not available to complete follow-up data. These families may have experienced greater need or more competing demands, particularly during COVID-19, introducing bias. The intervention caregivers who remained in the study may have also had a different level of interest in infant development leading to biased sampling of enhanced self-report of positive interactions.

It is unclear why the baseline STIMQ scores were different between groups. It is possible that the reduced sample size impacted detection of findings. At baseline, the control group had significantly higher reported parent stimulation activities at home compared to the intervention group. This may indicate undetected differences in population despite similar baseline demographic data. Overall, the 2 hospitals serve similar populations in the same city. There may also be unidentified differences in pediatric practice activities that promote positive caregiver-child interactions that in turn led to baseline differences. The analytical approach of using change scores addresses these baseline differences when interpreting the data. Future studies with larger samples sizes could explore this more fully.

Some of the results can be attributed to general growth over time rather than the TREE specifically. Both the groups demonstrated significant STIMQ total core increases over time. This suggests parental language and cognitive developmental stimulation over time is likely a naturalistic function as children transition from infancy to toddlerhood and families have wider access to developmental information and experiences. Future studies with larger samples should be conducted to further differentiate natural developmental processes versus intervention impact.

In addition, the TREE questionnaire is a newly developed measure created specifically for the TREE project. Strengths are that it is highly aligned with the TREE learning objectives and reflective of the TREE specific

content. However, it has not yet been validated as a tool. It has been used in other TREE activities and has demonstrated face validity and provider acceptability, but it lacks rigorous reliability or validity analyses, requiring further study.

Future Directions

Future research should examine TREE's efficacy via a randomized controlled trial with a larger patient population and longer follow-up. Despite promising results, these should be interpreted with caution until future studies demonstrate similar outcomes. As this was a feasibility study, consideration of trending findings is warranted[54] and should be considered when designing future studies. Research should examine if TREE is effective when implemented by community-based pediatric practitioners and further explore if TREE presents a potential time burden to implement outside of pediatric residency sites. Whether TREE can be offered as a separate developmental office coaching visit in addition to well-child visits should be considered. Future research should also evaluate program efficacy when alternate practice providers (eg, office-based pediatric nurse practitioners, social workers, and psychologists) are trained to implement TREE without additional personnel expense. The TREE program is currently being adapted to provide during dedicated developmental home-based telehealth coaching sessions.

We could not examine the influence of provider demographics on TREE. There is emerging evidence that racial concordance between physicians and pediatric patients can improve health outcomes.[57,58] Concordance analysis between residents and caregivers was not possible. We do not have specific racial breakdown for providers. Generally, both groups were racially diverse but with a small portion of black providers and providers largely did not systematically match populations served at either site. Future studies with a larger sample examining if findings differ with provider-patient concordance could provide valuable insights.

Conclusion

This feasibility study highlights the TREE program as a promising practice to promote positive caregiver interactions with their young children and increase pediatric residents' perceptions of their competency in promoting positive caregiver-child interactions and conveying child development to families. The ability to address developmental and behavioral issues is an important component of pediatric residency programs,[59] with the AAP challenging pediatric providers to take up the mantle of relational health.[16] Training pediatric residents to promote positive early parent-child interactions align soundly with this challenge.

The TREE was intended to promote early relational health among families with negative SDOH and risk factors. The sample largely reflects families with historical disadvantages (84% black, 86% Medicaid recipients, 59% not employed full time), demonstrating positive effects with the intended population. The critical need for early relational health programs to be integrated into pediatric primary care as a public health measure to address the deleterious effects of the SDOH is established in the pediatric literature.[10,16,17,23] The TREE program introduces a universal intervention that addresses these social determinants by promoting PCEs and fostering early relational health.

The TREE program is a brief, inexpensive, easily replicated and learned, universal developmental coaching intervention delivered within a pediatric primary care setting directly by pediatric clinicians. Additional cost saving factors include successful regional Medicaid reimbursement and the availability of a free website with training content and materials. Findings demonstrate feasibility of TREE implementation within pediatric care, as well as acceptability to both pediatric providers and caregivers. Our data reveal that the program enhances caregiver-child interactions and operationalizes the call to promote relational health. We are hopeful that this study will contribute to the deeper ongoing professional conversation on how pediatric providers can actively implement specific practical interventions promoting PCEs, as well as resilience and health equity through capability building in families and communities with identified SDOH risk factors.

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