Informing Precision Home Visiting: Identifying Meaningful Subgroups of Families Who Benefit Most from Family Spirit

E. E. Haroz [1] · A. Ingalls [1] · C. Kee [1] · N. Goklish [1] · N. Neault [1] · M. Begay [1] · A. Barlow [1]

Abstract

The Maternal, Infant, and Early Childhood Home Visiting Program was reauthorized February 8, 2018, and invests $2 billion over 5 years to improve mothers' and children's outcomes across the life course. Along with this investment, the home-visiting field is striving for implementation innovations to deliver the greatest impact to the most families at the most efficient cost through a focus on precision home visiting. Consistent with the precision home-visiting approach to identify meaningful subgroups to guide content tailoring, the purpose of this paper is to answer (1) how and to what degree an evidence-based home-visiting model benefits mothers and children with substance use or depression and (2) what baseline characteristics indicate who can benefit most. We completed a secondary data analysis of the most recently completed randomized controlled trial (RCT) of Family Spirit ($N = 322$), a federally endorsed home-visiting intervention designed for young Native American mothers and their children. We examined how baseline differences in mothers' substance use, depression, and demographic characteristics (household mobility, education, parity, and premature birth) moderated mothers' and children's intervention-related outcomes. Children born to mothers with past substance use histories benefited more from the intervention than children born to abstinent mothers ($p < 0.01$). Unstable housing, parity, and low educational attainment emerged as moderators of intervention effectiveness. Results from this investigation will serve as a basis for designing and evaluating a precision approach to Family Spirit and may provide lessons for other models to explore tailoring variables for optimal impact and efficiency. Trial Registry: NCT00373750

Keywords Precision prevention science · Home visiting · Moderation analysis

Home-visiting programs provide critical support to families and young children to promote healthy development and reduce health disparities. Decades of research has yielded a robust evidence base supporting their effectiveness and impact on maternal and child outcomes (Casillas et al. 2016; Filene et al. 2013; Peacock et al. 2013). In 2010, under the Affordable Care Act, the importance of these interventions was recognized nationally with the authorization of $1.5 billion to fund the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) Program across states and tribes. The

MIECHV Program was reauthorized for five more years on February 8, 2018, through bi-partisan vote to support evidence-based home visiting to prevent child maltreatment and promote early childhood development as a national strategy to improve mothers' and children's outcomes across the life course. Given this investment ($2 billion–$400 million each year for 5 years), it is incumbent upon the home-visiting field to strive for innovations to deliver the greatest impact to the most families at the most efficient cost. To work toward achieving this goal, this paper will explore evidence toward filling two current gaps in the literature related to home visiting: (1) identifying meaningful subgroups of families to help in informing a precision approach to home visiting, and within this gap explicitly explore (2) if and how home visiting may address maternal substance use and depression?

Precision Home Visiting

Early childhood home visiting is primarily a one-size-fits-all approach. There are 20 federally endorsed early childhood

✉ E. E. Haroz
eharoz1@jhu.edu

[1] Center for American Indian Health, Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

home-visiting programs that serve pregnant mothers and their children from birth to 5 years of age, with rigorous evidence from either randomized controlled trials or quasi experimental designs. To achieve federal endorsement as an evidence-based program from the "Home Visiting Evidence of Effectiveness (HomVEE)" review, the intervention must be shown to impact on at least one of the following eight domains: (1) maternal health; (2) child health; (3) positive parenting practices; (4) child development and school readiness; (5) reductions in child maltreatment; (6) family economic self-sufficiency; (7) linkages and referrals to community resources; and (8) reductions in juvenile delinquency, family violence, and crime. However, a major gap in HomVEE evidence-based programming is the lack of evidence related to "the effectiveness of home-visiting models for different types of families with a range of characteristics" (Sama-Miller et al. 2016).

Until recently, home-visiting model developers have, in general, taken a one-size-fits-all approach within their program delivery. Enrolled mothers are intended to receive the same evidence-based program *content, sequence, and duration* regardless of how their needs may differ. While home-visiting models range in duration (e.g., Family Connects with two to three visits over the first year of life vs. Early Head Start with weekly visits up to 3 years postpartum) and target different outcomes (e.g., parenting, school readiness, maternal-child health), most include standard lesson sequencing and dosage with some latitude for home visitors to change program delivery based on their own judgement.

However, parents and children do not all need the same program content or dosages. Further, without clear guidance on how to tailor delivery, home visitors' judgements may compromise program fidelity. Recent evidence has also shown that across some models, families often receive a shorter dosage of home visiting in practice than what is recommended by the evidence-based program (Duggan et al. 2018). Results from the recent Mother Infant Home Visiting Evaluation Report found that only 50% of families who enrolled in home-visiting services were retained by 12 months (Duggan et al. 2018). The variability in dosage and retention indicate a need to rethink how to engage families. Tailoring the program has been found as one factor that affects engagement and retention, key mechanisms for home-visiting effectiveness (O'Brien et al. 2012).

Specific guidance is needed about how and when to tailor lessons to ensure home visitors are "practicing with evidence." There is emerging demand for new home-visiting strategies to address diverse and emergent needs of parents and children, while maintaining fidelity to the active ingredients of evidence-based programs (Duggan et al. 2013; HARC 2017). The Home Visiting Applied Research Collaborative have called this concept "precision home-visiting," and it is hypothesized to be a promising approach to achieve the best outcomes for each family (HARC 2017). Precision

home visiting is consistent with recent interests in the prevention field to help make effective interventions more efficient and effective at scale (Supplee et al. 2018).

Addressing Substance Use and Depression

Consistent with the precision home-visiting research agenda (HARC 2017), identifying meaningful subgroups of families and children is a priority. Past research has shown home visiting provides the greatest benefit to young, low-income, single mothers who generally have immediate behavioral and mental health risks (Dauber et al. 2017b). In particular, a large number of women served by home visiting are at high risk for substance use and depression, both known to impair parenting and negatively impact early childhood emotional and behavioral outcomes, including infant and toddler externalizing, internalizing, and dysregulation behavior problems (Granic and Patterson 2006; Hoffman 2006). In turn, when children experience externalizing, internalizing, and dysregulation disorders before age 3, they are at higher risk for early and problematic substance use and sexual activity in adolescence that ultimately perpetuate intergenerational cycles of behavioral and mental health disparities (Alati et al. 2005a; Briggs-Gowan and Carter 2008; Ramrakha et al. 2007).

While recent literature has focused on how to use home-visiting programs to connect at-risk mothers to available substance abuse and mental health treatment services (Dauber et al. 2017b; Legha et al. 2014), it remains to be determined: (1) which mothers in what circumstances may be directly benefitting from standard home visiting in terms of reducing their substance use or depression? and (2) how durable are children's benefits from home visiting when mothers are experiencing substance use or depression?

Current Study

The current study explored evidence from a randomized controlled trial (RCT) of Family Spirit to identify meaningful subgroups within the sample, including mothers at risk for substance use and depression, that benefitted most from the intervention and moderating variables that could guide future tailoring of Family Spirit in a precision approach. We conducted a secondary analysis of data collected from a RCT of the Family Spirit home-visiting intervention compared to optimized standard care among $n = 322$ teenage American Indian mother-child dyads living in four rural reservation communities. The Family Spirit intervention was designed over a decade-long period via community-based participatory research (CBPR) methods by the Johns Hopkins Center for American Indian Health in partnership with its longest-standing research collaborators, the White Mountain Apache,

San Carlos Apache, and Navajo tribal communities (Mullany et al. 2012). Evidence from the most recent RCT showed mothers in the Family Spirit intervention vs. control group from pregnancy to 36 months postpartum had significantly greater parenting knowledge (effect size = 0.42) and parental locus of control (effect size = 0.17), fewer depressive symptoms (effect size = 0.16) and externalizing problems (effect size = 0.14), and lower past month use of marijuana (odds ratio = 0.65) and illegal drugs (odds ratio = 0.67). Children in the intervention group had fewer externalizing (effect size = 0.23), internalizing (effect size = 0.23), and dysregulation (effect size = 0.27) problems (Barlow et al. 2015).

Family Spirit has been disseminated to over 122 different communities across 19 states nationwide with recommended dosing of at least 50% of lessons when implemented. Dosage is based on past evidence that effective home-visiting programs have generally planned for ~ 60 visits over a 1-to-5-year period and aimed to deliver between 32 and 56% of these visits (range 22–33 visits) (Gomby et al. 1999). Past Family Spirit trials established feasibility of proposed lesson schedule in the scaling sites (Mullany et al. 2012).

Our secondary analyses explored how baseline differences in mothers' substance use and depression, and demographic characteristics (household mobility, education, parity, and premature birth) moderated mothers' and children's intervention-related outcomes. The moderators selected for exploration were driven by Family Spirit's conceptual model (see Mullany et al. 2012 and "Moderators" section below).

Results from this trial have the potential to shed light on home visiting's role in serving mothers with substance use and/or depression and demographic characteristics that may signal pivot points for tailoring service delivery. Our approach is aimed to be hypothesis generating with the end goal of identifying characteristics that can help us to tailor intervention content to meet families' most salient needs, to best serve a range of different types of families, and to deliver services in the most personalized and efficient way.

Methods

We conducted secondary analysis of data from a completed RCT of the Family Spirit intervention compared to optimized standard of care between 2006 and 2012. Table 1 describes details of the measures included in this analysis and a CONSORT diagram of the trial in the supplemental material. Full details about the trial can be found elsewhere (Barlow et al. 2015).

Participants and Procedure

The trial was a multisite, randomized, parallel-group trial. Mothers were recruited in pregnancy and followed until 36 months postpartum in four reservation-based tribal communities in Arizona and New Mexico. Detailed study methods have been published previously (Mullany et al. 2012). To be eligible, participants had to be expectant Native American adolescents, aged 12–19 years at conception, and less than 32 weeks gestation. Exclusion criteria consisted of (1) currently participating in mental or behavioral research and/or (2) some other condition or life circumstance that precluded full participation in the intervention protocol. Participants were generally recruited from Indian Health Service clinics, WIC programs, schools, and word of mouth. All participants provided their consent/assent, and parent/guardian consent was obtained from participants younger than 18. The participants were young (14 to < 20 years old at baseline), Native American, predominantly single, living in rural, low-income reservation communities. They had high baseline rates of depressive symptoms (32%) and lifetime alcohol and illicit drug use (84%), and more than half experienced unstable housing (moving $\geq$ 2 times in past year).

Treatment Arms

Family Spirit was developed over a decade through a close collaboration between tribal and university partners. The intervention consisted of 43 structured lessons that covered a range of parenting topics and maternal behavioral and mental health problems. Family Spirit was delivered by local Native Family Health Educators, who were required to have a minimum of a high school degree or equivalent (i.e., GED), at least 2 years of additional job-related education or work experience, and the ability to speak in their native language and English. Lessons were designed to last about 1 h and were delivered on a one-on-one basis in the participants' homes. Home visits occurred weekly through pregnancy, biweekly until 4 months postpartum, monthly between 4 and 12 months postpartum, and bimonthly thereafter. Over the 3-year follow-up period for the RCT, Family Spirit retained 91% of families at 12 months postpartum and 83% at 36 months postpartum; the intervention endpoint, three fourths (74/2%) of participants completed at least 50% of expected lesson content by 24 months postpartum; and 66.7% completed 50% of remaining content by 36 months. Analysis of differential attrition showed significant effects for two variables: more mothers who abstained from substances during pregnancy dropped out of the intervention group and more mothers who reported never using tobacco stayed in the control group. There were no statistically significant differences in dosage by demographic characteristic ($p > 0.05$) (Barlow et al. 2015).

Both the Family Spirit and control groups received a version of optimized standard of care provided by Family Health Liaisons that included transportation to prenatal and well-baby clinic visits, pamphlets about child care, and community resources and referrals to local services (Mullany et al. 2012).

Table 1 Information about measures and variables used in analysis

Measure or variable	No. of items	Cronbach's alpha	Response scale
Parental competence			
Parenting knowledge	30 items	NA	Varied by question
Parenting locus of control (PLOC)	27 items	0.84	1 "strongly disagree" to 5 "strongly agree"
Maternal emotional and behavioral functioning			
Center for Epidemiologic Studies-Depression Scale	20 items	0.84	0 "rarely/none of the time" to 3 "most/all of the time"
Parenting Stress Index	36 items	0.94	1 "strongly disagree" to 5 "strongly agree"
Child outcomes			
Infant-Toddler Social and Emotional Assessment	126 items	Externalizing: 0.84 Internalizing: 0.80 Dysregulation: 0.89	0 "not true/rarely" to 2 "very true/often"
Moderators used in analysis			
Ever used alcohol/drugs	Single item	NA	0 = no 1 = yes
Early substance use (before 14)	Single item	NA	0 = no 1 = yes
Early binge drinking (before 14)	Single item	NA	0 = no 1 = yes
Risk of major depression at baseline	Single item	NA	0 = not at risk 1 = at risk
Household mobility	Single item	NA	0 = 1 home in last year 1 = > 1 home in last year
Maternal education status	Single item	NA	0 = no HS diploma 1 = HS diploma or higher
Parity	Single item	NA	0 = no previous children 1 = other children
Premature baby	Single item	NA	0 = baby born at term 1 = baby born premature

Measures

Outcome measures assessed (1) parental competence, (2) maternal emotional and behavioral health outcomes, and (3) child emotional and behavioral health outcomes. Details of the study measures can be found in Barlow et al. (2015). Briefly, we examined the following:

Parental Competence Parental competence was assessed using a measure of parenting knowledge and parenting locus of control. The knowledge test was self-administered at baseline, 12, 24, and 36 months. The parenting locus of control (PLOC) measure (Campis et al. 1986) was self-administered at 2, 6, 12, 24, 30, and 36 months.

Maternal Emotional and Behavioral Functioning Maternal emotional and behavioral functioning was measured through the Center for Epidemiologic Studies-Depression Scale (CES-D; Radloff 1977) and the Parenting Stress Index (PSI)-Short Form (Abidin 1995). The CES-D is a 20-item self-report scale and was administered at baseline, 36 weeks gestation, 2, 6, 12, 18, 24, 30, and 36 months. The PSI includes 36 items and was administered at 24 and 36 months.

Child Outcomes Child outcomes were measured using the Infant-Toddler Social and Emotional Assessment (ITSEA) (Carter et al. 2003), a 126-item parental report that covers domains of externalizing behaviors, internalizing behaviors, dysregulation, and competence. The ITSEA was administered at 12, 18, 24, and 36 months postpartum. For the purposes of the current analyses, we examined only the externalizing, internalizing, and dysregulation domains.

Moderators

Moderators included in the present analysis were derived a priori from Family Spirit's theoretical model (Mullany et al. 2012). Family Spirit's theoretical model is based on G.R. Patterson's ecologically focused parent-child development theory (Patterson et al. 1989) (see Fig. 1) that posits parenting as the critical link between parents' personal factors, demographic risks and stressors, and their children's risk factors and

Fig. 1 Conceptual model: G.R. Patterson's ecologically focused parent-child development theory moderators adapted for Family Spirit
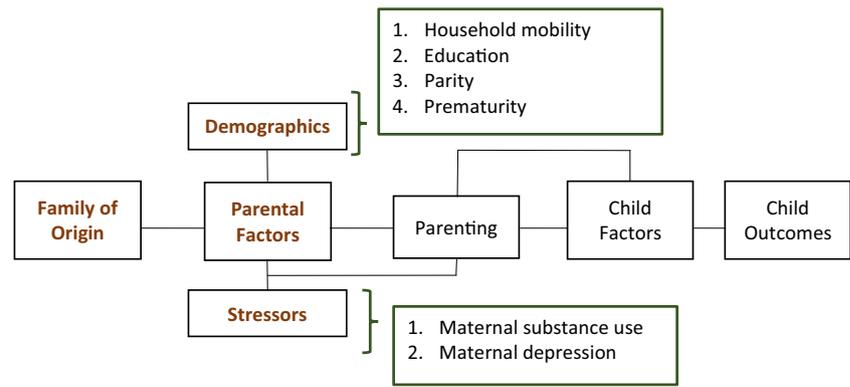
ultimate outcomes. In the Native American populations that participated in the design of Family Spirit, the most sentinel personal factors for parents included substance use, depression, and low parental self-efficacy. Family Spirit has lessons that address these issues (Table 2). Key demographic risks included young parenthood, poverty, low education, and unstable housing. Key stressors included adverse life events, overcrowded housing, additional children born to young mothers, and domestic conflict. Based on Patterson's model, the Family Spirit intervention was designed to promote effective parenting, while assisting mothers in developing coping and problem-solving skills to overcome personal and demographic stressors as a dual pathway to promote children's optimal emotional and behavioral development.

Based on this model, for gap 1, we explored the moderating effects of maternal substance abuse and depression on mothers' and children's intervention-related outcomes. Specific moderators included the following: (1) having ever used alcohol, marijuana, or any hard drug (i.e., barbiturates, crack, inhalants, or methamphetamine); (2) alcohol/marijuana risk defined by having initiated use of these substances prior to age 14; (3) whether or not a participant reported having a binge drinking episode prior to age 14; and (4) risk of major depressive disorder at baseline (CES-D score of 16 or higher). Substance use variables were based on responses at baseline to the Voices of Indian Teens Survey (Novins and Mitchell 1998).

For gap 2, we looked at how demographic characteristics that varied across our participant sample moderated maternal and child intervention-related outcomes. Selected demographic

moderators included the following: (1) household mobility (having lived in more than 1 home in the past year); (2) maternal education status; (3) parity; and (4) having a premature baby (collected after enrollment, at birth). We hypothesized that the presence or absence of these characteristics may relate to how well Family Spirit works and serves as potential tailoring variables for future intervention delivery. For example, if parity was a moderator and mothers with more than one child benefitted less from the intervention, this might suggest an opportunity to shorten or limit the intervention for these more experienced mothers (Table 1).

Statistical Analyses

Effect Modification All analyses followed an intent-to-treat approach. Missing data was determined to be missing at random (MAR). Missing data was addressed through the application of maximum likelihood estimation. Linear mixed-effect regression models, using autoregressive correlation matrices, were estimated to measure adult and child outcomes separately. We estimated average change in parenting knowledge, PLOC scores, and maternal depression symptoms from baseline to 36 months. For parenting stress, we examined average change on the PSI across the 24- to 36-month outcomes. For all child outcomes, average change in outcome variable from 12 to 36 months was estimated. Separate models were estimated for each moderator.

All models included fixed direct effects of treatment arm (Family Spirit = 1; OSC = 0), time, and moderator. Based on previous analyses, we used restricted maximum likelihood

Table 2 Family Spirit lessons focused on substance abuse/depression or maternal coping/problem-solving

Lesson name	Delivery time point	Domain
Effects of Substance Abuse on a Fetus, Child and Family	30 weeks gestation	Substance use
What are Drugs	12 weeks postpartum	Substance use
Goal Setting	28 weeks gestation	Maternal coping/problem-solving
Living Healthy: Avoiding the Pain Drugs-PART A	14 months pp	Maternal coping/problem-solving
Living Healthy: Avoiding the Pain Drugs-PART B	14 months 1 week pp	Maternal coping/problem-solving
Communication and Building Healthy Relationships	34 months pp	Maternal coping/problem-solving

estimation and included study site, mother's age, the sex and age of the child (in months) at time of assessment, maternal depressive symptoms at baseline, lifetime cigarette use, and alcohol or illegal drugs use during pregnancy (Barlow et al. 2015). Random effects included repeated measures by participant.

A two-way interaction term of moderator X treatment arm and all lower order interactions were included in all models. This two-way interaction coefficient indicates whether change in average outcome varies by levels of the moderator while controlling for change in the control group. When a two-way interaction term was significant, we re-estimated the models stratified by level of the moderator and displayed the stratified results. Effect sizes for significant effects were calculated. Significance was set at $p = 0.050$. As this was an exploration of moderation, we did not adjust the p value for multiple comparisons.

Results

Participants

Demographic characteristics are summarized in Table 3. At baseline, the vast majority were single, had completed some high school, and had not planned their pregnancies. Nearly one quarter ($n = 75$; 23.3%) had previous children, and 13% had a premature baby (determined at time of birth). Half of expectant mothers (50.6%) had lived in more than 1 home prior to starting the trial and just over 50% used food stamps to help supplement their income. Approximately 16% of participants had never used alcoholic beverages and 22% had not previously used any illicit drugs. More than two thirds of the sample received the recommended dose of Family Spirit through 36 months postpartum, while 83% were retained to this endpoint of the trial.

Moderators of Family Spirit's Effects

Substance Use and Depression Neither maternal baseline substance use nor depression risk moderated the impact of Family Spirit on maternal outcomes. However, for child outcomes, a past history of alcohol or marijuana use significantly moderated the impact of Family Spirit across outcomes. Children of mothers who reported a past history of either alcohol or marijuana ($n = 215$) improved more on dysregulation ($b = -0.18$, $p = 0.026$), internalizing ($b = -0.20$, $p = 0.004$), and externalizing behaviors ($b = -0.29$, $p = 0.002$) than children of mothers without this history ($n = 46$). There were no statistically significant differences in these ITSEA scores by mother's substance use histories at the 12-month time point (baseline for ITSEA measure), indicating that the impact on child outcomes was not due to differences in children's initial

scores on the measure. Family Spirit had medium to high effects across child outcomes for children born to mothers with substance use histories (Table 4).

Toward Precision Home Visiting: Investigation of Demographic Characteristics Maternal outcomes are presented in Table 5. Overall, Family Spirit increased parenting knowledge. However, these effects were stronger for mothers with a high school degree compared to mothers without a high school degree ($b = 1.30$, $p = 0.050$). High home mobility moderated the impact of Family Spirit on parent self-efficacy (PLOC), with mothers who reported living in more than one home in the year prior to baseline having higher PLOC scores (worse parent self-efficacy) compared to mothers who lived in stable housing ($b = 4.26$, $p = 0.031$). Home mobility also moderated the impact of Family Spirit on children's dysregulation behaviors ($b = 0.11$, $p = 0.035$), with children in unstable homes benefitting less from Family Spirit. Finally, parity was also a moderator. In terms of parity, children of mothers with previous children improved more on active/impulsive behaviors compared to children of first-time mothers after adjusting for baseline covariates ($b = -0.23$, $p = 0.009$) (Table 3). Having a premature baby did not moderate the impact of Family Spirit maternal or child outcomes. No variable tested moderated the impact of Family Spirit on maternal stress or depression.

Discussion

Our research aimed to explore two gaps in the home-visiting literature: (1) how and to what degree is Family Spirit home visiting benefitting mothers and children when mothers report substance use or depression at time of enrolment and (2) what demographic characteristics indicate which mothers and their children can benefit most from home visiting. Using baseline data from our Family Spirit trial with reservation-based expectant teen mothers, we identified several moderators of intervention impact that illustrate for whom and under what circumstances Family Spirit works best. In line with current precision home-visiting frameworks (HARC 2017), these moderators generate potential hypotheses about meaningful subgroups in our sample to inform tailoring of the Family Spirit.

We found no evidence that maternal substance use and depression risk at baseline moderated the impact of Family Spirit on mothers' mental health. However, past maternal substance use at baseline did moderate children's outcomes. Children born to mothers with substance use histories improved more across a range of emotional and behavioral outcomes (externalizing, internalizing, and active/impulsive behaviors, dysregulation) compared to children born to mothers without a substance use history. The substance use findings are encouraging for the home-visiting field that targets

Table 3 Demographic characteristics and intervention dosage of participants

N		322
Study arm	Control	163 (50.6%)
	FS	159 (49.4%)
Age group	18 or younger	136 (42.2%)
	Over 18	186 (57.8%)
Number of homes lived in during past year	1 home	159 (49.4%)
	More than 1 home	163 (50.6%)
Uses food stamps?	No	167 (51.9%)
	Yes	155 (48.1%)
Currently in school?	No	191 (59.3%)
	Yes	131 (40.7%)
Farthest gone in school	Grades 6–8	23 (7.1%)
	Grades 9–11	211 (65.5%)
	HS diploma/GED	66 (20.5%)
	Some tech school/college	22 (6.8%)
Any other children at baseline?	No	247 (76.7%)
	Yes	75 (23.3%)
Baby born prior to 37 weeks gestation?	No	275 (87.3%)
	Yes	40 (12.7%)
Previous use of alcohol	No	51 (15.8%)
	Yes	271 (84.2%)
Previous use of any illicit drugs	No	71 (22.1%)
	Yes	251 (77.9%)
Dosage (lessons completed)	Less than 50%	50 (31.3%)
	50–98%	67 (41.9%)
	100%	43 (26.9%)

disadvantaged, young, poor mothers who are high risk for substance use. These findings also offer a counter solution to prior research showing infants and toddlers reared by mothers at high risk for substance abuse have poorer early developmental outcomes that predict behavior problems over the life course (Alati et al. 2005b).

Family Spirit offers in-home education from a culturally matched paraprofessional home visitor equipped with structured curriculum that focused both on providing mothers coping and problem-solving skills as well as comprehensive child care and positive parenting education, as well as targeted lessons on the harms of substance abuse to mothers and babies, peer refusal, and positive peer selection skills. This comprehensive strategy of addressing mothers' risk and protective factors for substance use while simultaneously promoting sensitive and nurturing parenting proved potent enough to buffer children from the direct impact of maternal substance use on early childhood behavior problems (Calhoun et al. 2015; Stanger et al. 2004). Given this positive outcome, we could potentially amplify Family Spirit's impact by prescreening and selecting expectant teen mothers who endorse substance use histories. This proposed strategy

is not suggesting home visiting can replace some mothers' needs for substance use treatment. Rather, for mothers at risk but not so affected that they are not able to engage in a standard dose of home-visiting lessons, Family Spirit was able to reduce the transmission of early behavior problems associated with maternal substance use and children's future risk of substance use. In terms of precision home visiting, mothers who report substance use histories but without signs of active addiction may be the best candidates for the Family Spirit intervention. Family Spirit and similar behavioral-focused home-visiting interventions may be most impactful for subgroups of mothers at selected or indicated levels of substance use risk (O'Connell et al. 2009).

For our investigation into meaningful subgroups based on demographic characteristics, it is critical to emphasize that overall, mothers and children in Family Spirit experienced significantly better outcomes on a range of social-emotional and behavioral outcomes, compared to the control group (Barlow et al. 2015). However, our investigation into moderators was designed to explore which mother-child dyads in Family Spirit might need more or less content to achieve optimal benefits.

Table 4 Moderators of Family Spirit's impact on child outcomes

	Average Effect FS Mean (95% CI)	Average Effect Control Mean (95% CI)	Difference between FS and Control Mean (95% CI)	Cohen's d
Dysregulation				
Overall	0.70 [0.33, 1.01]	0.76 [0.40, 1.13]	-0.06 [-0.11, -0.01]*	0.35
Past substance use				
No Use ($n=46$)	0.88 [-0.14, 1.89]	0.76 [-0.2, 1.75]	0.12 [-0.06, 0.30]	--
Past Use ($n=215$)	0.73 [0.33, 1.12]	0.81 [0.41, 1.21]	-0.08 [-0.14, -0.03]**	0.57
Home Mobility				
1 home ($n=159$)	0.32 [-0.24, 0.88]	0.45 [-0.11, 1.01]	-0.13 [-0.21, -0.05]**	0.58
More than 1 home ($n=163$)	1.05 [0.57, 1.52]	1.05 [0.58, 1.52]	-0.01 [-0.07, 0.07]	--
Internalizing				
Overall	0.57 [0.26, 0.88]	0.62 [0.31, 0.93]	-0.05 [-0.09, -0.01]*	0.29
Past substance use				
No Use ($n=46$)	1.04 [0.17, 1.91]	0.91 [0.07, 1.75]	0.13 [-0.02, 0.28]	--
Past Use ($n=215$)	0.56 [0.23, 0.90]	0.63 [0.30, 0.97]	-0.07 [-0.12, -0.03]**	0.58
Externalizing				
Overall	0.80 [0.36, 1.24]	0.87 [0.43, 1.30]	-0.07 [-0.13, -0.01]*	0.29
Past substance use				
No Use ($n=46$)	0.95 [-0.49, 2.38]	0.77 [-0.62, 2.17]	0.17 [-0.08, 0.43]	--
Past Use ($n=215$)	0.84 [0.38, 1.30]	0.94 [0.49, 1.40]	-0.10 [-0.16, -0.04]**	0.41

*$p < 0.05$
**$p < 0.01$

Mothers with high school degrees, with previous children, and with stable housing and their children experienced stronger intervention effects compared to their counterparts without these conditions. These findings beg several questions: first, do mothers with these characteristics need the full dose of Family Spirit to achieve positive outcomes? For example, second-time mothers may not need as many lessons on child care (i.e., diapering, breastfeeding, sleep routines). Likewise, do mothers without these characteristics need additional support? For example, should mothers in unstable housing receive specialized support on maintaining child routines in unstable living situations.

Indeed, in this analysis, home mobility emerged as a modifier of a number of outcomes, including parent self-efficacy and child dysregulation behaviors. It is has been shown to be

Table 5 Moderators of Family Spirit's impact on maternal outcomes

	Average effect FS Mean [95% CI]	Average effect control Mean [95% CI]	Difference between FS and control Mean [95% CI]	Cohen's d
Parenting knowledge				
Overall	14.8 [10.1, 19.4]	13.3 [8.6, 17.9]	1.5 [0.9, 2.2]***	0.66
Education				
No high-school degree ($n = 234$)	10.0 [6.1, 14.0]	10.7 [6.7, 14.7]	0.7 [0.1, 1.30]**	0.28
High school degree or higher ($n = 88$)	14.6 [−0.7, 30.1]	12.9 [−2.5, 28.3]	1.7 [0.4, 3.0]**	0.62
Parenting locus of control				
Overall	67.1 [54.3, 80.0]	69.0 [56.1, 81.8]	−1.86 [−3.8, 0.1]	–
Home mobility				
1 home ($n = 159$)	58.0 [37.8, 78.3]	62.3 [42.0, 82.6]	−4.3 [−7.3, −1.3]**	0.56
More than 1 home ($n = 163$)	76.1 [59.4, 92.8]	75.7 [59.2, 92.4]	0.3 [−2.2, 2.9]	–

**$p < 0.01$; ***$p < 0.001$

feasible to provide home-visiting services to mothers in unstable living situations (Barlow et al. 2018), but additional services such as addressing housing issues or offering tailored education to help mothers' parent in unstable situations may help mothers and children maximally benefit from the support offered by home-visiting programs (Holland et al. 2014; Staerkel and Spieker 2006).

The fact that our findings demonstrated certain moderators improved or attenuated intervention benefits offer potential "pivot points" to tailor Family Spirit to meet families' diverse needs. Applying a tailored research approach to home visiting could also improve efficiency, impact, and family engagement (Supplee et al. 2018). Drawing additional evidence from the psychotherapy field, transdiagnostic or common elements approaches to delivery of evidence-based mental health treatments are attracting increased attention. Common elements interventions teach a set of common practice elements that can be delivered in a variety of combinations, sequences, and dosages based on clients' needs. Instead of teaching interventionists to adhere to a certain sequence and dose of a treatment, interventionists are taught decision rules based on evidence that guides the selection and sequencing of elements (Chorpita et al. 2005). The evidence base for transdiagnostic interventions is growing and promising (McHugh and Barlow 2010; Newby et al. 2015), including in low-resource contexts and with paraprofessional interventionists (Bolton et al. 2014; Murray et al. 2014). A similar approach to home visiting seems logical: instead of lessons delivered in a standard series with standard dosages, we equip home visitors with the means to modify intervention delivery accordingly.

The results from the current study will inform our work toward designing a precision approach to implementing Family Spirit with the goals to (1) preferentially recruit participants whom we know can benefit most; (2) help guide home visitors' ability to respond to participants' immediate and personal needs with fidelity; (3) reduce the dosage of the intervention for high responders if they no longer need the content; (4) identify and add what is missing from the intervention to assist those who did not benefit as much; and (5) refer participants with immediate needs beyond home visiting's scope to adjunctive services (i.e., housing assistance or substance abuse treatment) while maintaining a relationship to engage them when they are ready.

Limitations

This study was a secondary data analysis of a completed RCT. Thus, our sample size was not specifically designed to examine moderators of intervention effects and we have limited power to detect these effects. It is still important in any RCT to examine moderators if feasible. While we did find evidence for some moderators, our findings should be considered hypothesis generating. Future studies should be designed to explicitly build stratification analyses into the research questions (Cook et al. 2004; Kraemer et al. 2002). Where we found no evidence of moderation, it is impossible to determine whether this is true or if it is due to being underpowered. As this was a secondary data analysis, all limitations from the original RCT study, including concerns about generalizability, response bias with self-report measures, and large number of study outcomes, are also applicable (Barlow et al. 2015).

Conclusions

For home visiting to deliver the greatest impact to the most families at the lowest cost, we must strive to understand what types of families can benefit most and how programs can be attuned to families' specific needs. Due to increased recognition that the majority of mothers who are being recruited for home-visiting programs today suffer notable behavioral health risks, there has been a call for "model enhancements and interventions designed to increase home-visiting program capacity to address client behavioral health risks" (Dauber et al. 2017a, p. 409). This analysis of results from the latest RCT of the evidenced-based Family Spirit home-visiting intervention took some steps toward that end. We did not find evidence to support differential benefits for mothers with high depression symptoms compared to those with low levels of symptoms. However, the analysis indicated the potential of home visiting to serve as a preventive tool to break intergenerational cycles of substance misuse for children of mothers at the "selective" and "indicated" levels of substance use prevention. Finally, three key demographic characteristics stood out as potential pivot points for model enhancements: mothers experiencing housing instability appear to require immediate adjunctive services before they and their children can benefit from home-visiting interventions, and parity (more than 1 child) and education status (less than a high school degree) may be pivot points for adjusting dose of home-visiting content for optimal impact and efficiency. Continued research is needed to discover, apply, and test tailoring variables to improve home visiting's impact and efficiency in order to achieve the greatest return on investment for the newly re-authorized MIECHV Program.

Data Availability The datasets generated during and/or analyzed during this study are not publicly available as they are owned by the participating Native American communities. Requests to obtain the datasets must be made to the participating communities' governing bodies.

Compliance with Ethical Standards

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